

CHAPTER 6 REVIEW EXERCISES

Section 6.1

Verify that the given values of x solve the corresponding polynomial equations.

- $4x^3 - 5x^2 = -3x + 18; x = 2$
- $x^2 - 6x = -13; x = 3 + 2i$
- $x^3 + x = 6x^2 - 164; x = 5 - 4i$
- $x^3 + (1 + 4i)x = (7 - 2i)x^2 - 2i + 36; x = -2i$

Solve the following polynomial equations by factoring and/or using the quadratic formula, making sure to identify all the solutions.

- $x^4 - 7x^2 + 10 = 0$
- $x^5 - x^3 - 2x = 0$
- $x^4 + 4 = 4x^2$
- $6x^2 + 8x = -x^3$
- $x^4 + x^3 = x^2$
- $x^2 + 4x + 7 = 0$

For each of the following polynomial functions, determine the behavior of its graph as $x \rightarrow \pm\infty$ and identify the x - and y -intercepts. Use this information to then sketch the graph of each polynomial.

- $f(x) = (x+2)(x-1)(x-3)$
- $f(x) = (x-2)^2(x+1)^2$
- $g(x) = x^2 - 5x + 4$
- $h(x) = -x^3 - 7x^2 - 10x$

Solve the following polynomial inequalities.

- $2x^2 + 15 \leq 11x$
 - $(x-3)^2(x+1)^2 > 0$
 - $(x-4)(x+2)(x^2-1) \leq 0$
 - $x^3 - 2x^2 - 8x \geq 0$
 - $x^2(x-2)(1-x) < 0$
 - $-3x^2 + 7x - 2 > 0$
21. A manufacturer has determined that the revenue from the sale of x video games is given by $r(x) = -x^2 + 12x$. The cost of producing x video games is $C(x) = 120 - 22x$. Given that profit is revenue minus cost, what value(s) for x will give the company a nonnegative profit?

Section 6.2

Use polynomial long division to rewrite each of the following fractions in the form

$q(x) + \frac{r(x)}{d(x)}$, where $d(x)$ is the denominator of the original fraction, $q(x)$ is the quotient, and $r(x)$ is the remainder.

- $\frac{8x^4 - 6x^3 + 2x^2 + 3x + 4}{2x^2 - 1}$
- $\frac{11x^2 + 2x - 5}{x - 3}$
- $\frac{x^4 - 3x^2 + x - 8}{x^2 + 3x + 2}$
- $\frac{2x^5 - 4x^3 - x^2 + x - 2}{x^2 - x}$
- $\frac{2x^3 + ix^2 - 12x - 4 + i}{2x + i}$

Use synthetic division to determine if the given value for c is a zero of the corresponding polynomial. If not, determine $p(c)$.

27. $p(x) = 6x^5 - 23x^4 - 95x^3 + 70x^2 + 204x - 72$; $c = 1$

28. $p(x) = 48x^4 + 10x^3 - 51x^2 - 10x + 3$; $c = \frac{1}{6}$

29. $p(x) = 18x^5 - 87x^4 + 110x^3 - 28x^2 - 16x + 3$; $c = \frac{2}{3}$

Use synthetic division to rewrite each of the following fractions in the form $q(x) + \frac{r(x)}{d(x)}$, where $d(x)$ is the denominator of the original fraction, $q(x)$ is the quotient, and $r(x)$ is the remainder.

30. $\frac{x^4 - 2x^3 - x^2 + x - 21}{x - 3}$

31. $\frac{-x^4 - x^3 - x^2 + 2x + 69}{x + 3}$

32. $\frac{x^5 + 2x^4 + 3x^3 + 6x^2 - 5x + 13}{x + 2}$

33. $\frac{-x^4 + 8x^3 - 6x^2 - 4x + 2}{x - 1}$

34. $\frac{x^4 + (4 - 2i)x^3 - (1 + 8i)x^2 + (3 + 2i)x - 6i}{x - 2i}$

Construct a polynomial function with the stated properties.

35. Second-degree, zeros of -2 and 6 , and goes to ∞ as $x \rightarrow \infty$.

36. Fourth-degree and a single x -intercept of -4 and y -intercept $(0, 128)$.

37. Third-degree, zeros of ± 2 and 3 and passing through the point $(4, 24)$.

Section 6.3

List all of the potential rational zeros of the following polynomials. Then use polynomial division and the quadratic formula, if necessary, to identify the actual zeros.

38. $f(x) = x^4 + 3x^3 - 3x^2 - 11x - 6$

39. $g(x) = 2x^3 - 11x^2 + 18x - 9$

40. $h(x) = 2x^3 + 2x^2 - 9x + 9$

41. $p(x) = x^4 + 8x^3 + 22x^2 + 24x + 9$

Using the Rational Zero Theorem or your answers to the preceding problems, solve the following polynomial equations.

42. $2x^4 - 6x^2 = -6x^3 + 22x + 12$

43. $2x^3 - 9x^2 + 18x = 9 + 2x^2$

44. $2x^3 + 9 = 9x - 2x^2$

45. $x^4 - x^5 = -x^5 - 8x^3 - 22x^2 - 24x - 9$

Use Descartes' Rule of Signs to determine the possible numbers of positive and negative real zeros of each of the following polynomials.

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

47. $g(x) = x^6 - 4x^5 - 2x^4 + x^3 - 6x^2 - 11x + 6$

Use synthetic division to identify integer upper and lower bounds of the real zeros of the following polynomials.

48. $f(x) = 2x^3 - 11x^2 + 3x + 36$

49. $g(x) = 4x^3 - 16x^2 - 79x - 35$

Using your answers to the preceding problems, polynomial division, and the quadratic formula, if necessary, find all of the zeros of the following polynomials.

50. $f(x) = 2x^3 - 11x^2 + 3x + 36$

51. $g(x) = 4x^3 - 16x^2 - 79x - 35$

Use the Intermediate Value Theorem to show that each of the following polynomials has a real zero between the indicated values.

52. $f(x) = 2x^4 - 6x^3 + x - 5$; -2 and 0

53. $f(x) = -x^3 + 3x^2 + x - 3$; 2 and 4

Find all of the real zeros of the following functions.

54. $f(x) = x^4 - 5x^3 + 5x^2 + 5x - 6$

55. $g(x) = x^3 - 4x^2 + 9x - 36$

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

57. $f(x) = x^3 - 7x^2 + 13x - 3$

Solve the following equations.

58. $x^4 - 2x^3 + 10x^2 = 9(2x - 1)$

59. $2x^3 = 7x^2 - 4x - 4$

60. $-8 = 3x^3 + 4x^2 + 6x$

Section 6.4

Throughout these exercises, a graphing utility may be helpful in identifying zeros and in checking your graphs.

Sketch the graph of each factored polynomial.

61. $f(x) = (x + 4)^2(x - 1)$

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

Factor each of the following polynomials completely, and then sketch the graph of each one.

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

64. $f(x) = x^5 - x^4 - 2x^3 - x^2 + x + 2$

Solve each polynomial equation.

65. $3x^5 + x^4 + 5x^3 = x^2 + 28x + 20$

66. $8x^5 + 12x^4 - 18x^3 - 35x^2 = 18x + 3$

67. $x^5 + 3x^4 + 3x^3 + 9x^2 = 4(x + 3)$

Factor each of the following polynomials completely, making use of the given zero.

68. $f(x) = 14x^4 - 109x^3 + 296x^2 - 321x + 70$; $2 + i$ is a zero

69. $f(x) = x^4 - 5x^3 + 19x^2 - 125x - 150$; $-5i$ is a zero

70. $f(x) = 2x^4 + 3x^3 - 7x^2 + 8x + 6$; $1 + i$ is a zero

71. $f(x) = 4x^3 + 10x^2 - x + 15$; -3 is a zero

Construct polynomial functions with the stated properties.

72. Fourth-degree, only real coefficients, $\frac{1}{2}$ and $1 + 2i$ are two of the zeros, y -intercept is -30 , leading coefficient is 2 .

73. Fifth-degree, only real coefficients, -1 is a zero of multiplicity 3 , $\sqrt{6}$ is a zero, y -intercept is -6 , leading coefficient is 1 .

74. Fifth-degree, only real coefficients, 1 is a zero of multiplicity 3 , $\sqrt{3}$ is a zero, y -intercept is 3 , leading coefficient is 1 .

Section 6.5

Find equations for the vertical asymptotes, if any, for each of the following rational functions.

75. $f(x) = \frac{4}{2x - 5}$

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

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

78. $f(x) = \frac{x^2 - x - 6}{x^2 - 6x + 9}$

Find equations for the horizontal or oblique asymptotes, if any, for each of the following rational functions.

79. $f(x) = \frac{2x^3 + 5x^2 - 1}{x^2 - 2x}$

80. $f(x) = \frac{x^2 - x + 8}{3x^2 - 7}$

81. $f(x) = \frac{x^2 - 9}{x + 3}$

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

Sketch the graphs of the following rational functions.

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

84. $f(x) = \frac{4x^2}{x^2 + 3x}$

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

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

Solve the following rational inequalities.

87. $\frac{7}{x + 3} \geq \frac{2x}{x + 3}$

88. $\frac{x}{x^2 - 5x + 6} \leq \frac{3}{x^2 - 5x + 6}$

89. $\frac{x - 4}{x + 3} < \frac{x}{x - 2}$

90. $\frac{x - 2}{x + 3} < 2$