

SECTION 2.2 SUMMARY

In general, polynomials can be graphed in one of two ways:

Use graph-shifting techniques with power functions.

General polynomial function.

1. Identify intercepts.
2. Determine each real zero and its multiplicity, and ascertain whether the graph crosses or touches the x -axis there.

3. x -intercepts (real zeros) divide the x -axis into intervals. Test points in the intervals to determine whether the graph is above or below the x -axis.
4. Determine the end behavior by investigating the end behavior of the highest degree monomial.
5. Sketch the graph with a smooth curve.

SECTION 2.2 EXERCISES

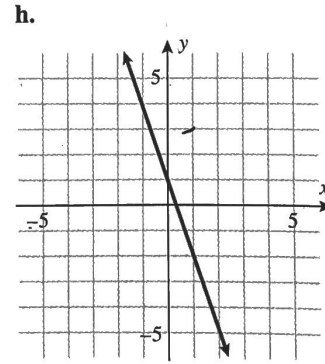
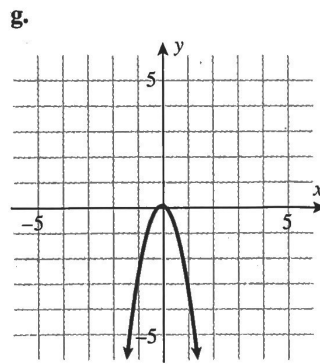
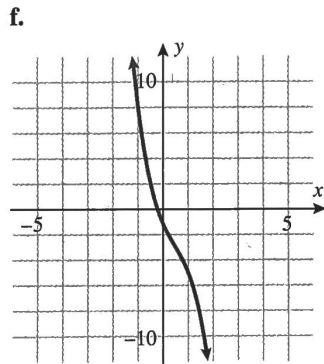
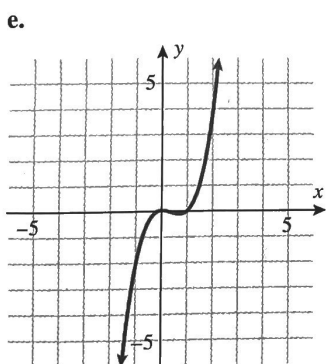
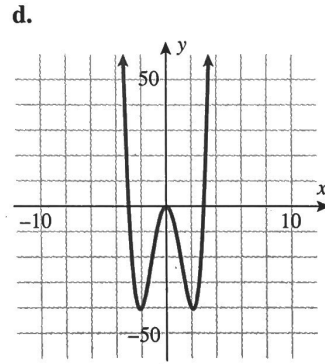
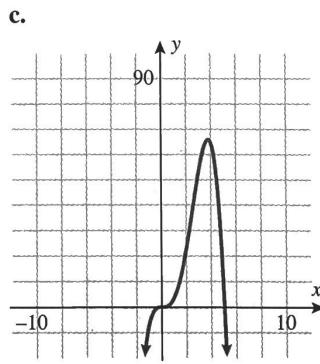
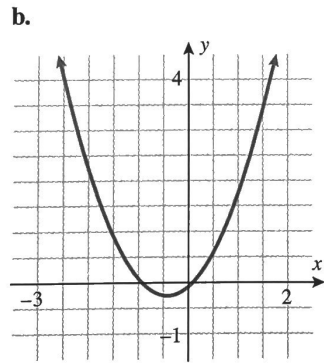
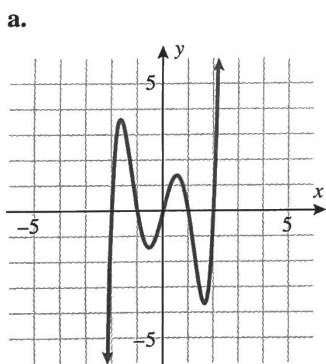
SKILLS

In Exercises 1–10, determine which functions are polynomials, and for those that are, state their degree.

1. $g(x) = (x + 2)^3(x - \frac{3}{5})^2$
2. $g(x) = (x - \frac{1}{4})^4(x + \sqrt{7})^2$
3. $g(x) = x^5(x + 2)(x - 6.4)$
4. $g(x) = x^4(x - 1)^2(x + 2.5)^3$
5. $h(x) = \sqrt{x} + 1$
6. $h(x) = (x - 1)^{1/2} + 5x$
7. $F(x) = x^{1/3} + 7x^2 - 2$
8. $F(x) = 3x^2 + 7x - \frac{2}{3x}$
9. $G(x) = \frac{x + 1}{x^2}$
10. $H(x) = \frac{x^2 + 1}{2}$

In Exercises 11–18, match the polynomial function with its graph.

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|------------------------|---------------------------|--------------------------|--------------------------------|
| 11. $f(x) = -3x + 1$ | 12. $f(x) = -3x^2 - x$ | 13. $f(x) = x^2 + x$ | 14. $f(x) = -2x^3 + 4x^2 - 6x$ |
| 15. $f(x) = x^3 - x^2$ | 16. $f(x) = 2x^4 - 18x^2$ | 17. $f(x) = -x^4 + 5x^3$ | 18. $f(x) = x^5 - 5x^3 + 4x$ |



In Exercises 19–24, graph each function by transforming a power function $y = x^n$.

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

20. $f(x) = (x + 2)^5$

21. $f(x) = x^5 + 3$

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

23. $f(x) = 3 - (x + 1)^4$

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

In Exercises 25–36, find all the real zeros (and state their multiplicities) of each polynomial function.

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

26. $f(x) = -3(x + 2)^3(x - 1)^2$

27. $f(x) = 4x^2(x - 7)^2(x + 4)$

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

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

30. $f(x) = 4x^2(x^2 - 1)(x^2 + 9)$

31. $f(x) = 8x^3 + 6x^2 - 27x$

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

33. $f(x) = -2.7x^3 - 8.1x^2$

34. $f(x) = 1.2x^6 - 4.6x^4$

35. $f(x) = \frac{1}{3}x^6 + \frac{2}{5}x^4$

36. $f(x) = \frac{2}{7}x^5 - \frac{3}{4}x^4 + \frac{1}{2}x^3$

In Exercises 37–50, find a polynomial (there are many) of minimum degree that has the given zeros.

37. $-3, 0, 1, 2$

38. $-2, 0, 2$

39. $-5, -3, 0, 2, 6$

40. $0, 1, 3, 5, 10$

41. $-\frac{1}{2}, \frac{2}{3}, \frac{3}{4}$

42. $-\frac{3}{4}, -\frac{1}{3}, 0, \frac{1}{2}$

43. $1 - \sqrt{2}, 1 + \sqrt{2}$

44. $1 - \sqrt{3}, 1 + \sqrt{3}$

45. -2 (multiplicity 3), 0 (multiplicity 2)

46. -4 (multiplicity 2), 5 (multiplicity 3)

47. -3 (multiplicity 2), 7 (multiplicity 5)

48. 0 (multiplicity 1), 10 (multiplicity 3)

49. $-\sqrt{3}$ (multiplicity 2), -1 (multiplicity 1), 0 (multiplicity 2), $\sqrt{3}$ (multiplicity 2)

50. $-\sqrt{5}$ (multiplicity 2), 0 (multiplicity 1), 1 (multiplicity 2), $\sqrt{5}$ (multiplicity 2)

In Exercises 51–68, for each polynomial function given: (a) list each real zero and its multiplicity; (b) determine whether the graph touches or crosses at each x -intercept; (c) find the y -intercept and a few points on the graph; (d) determine the end behavior; and (e) sketch the graph.

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

52. $f(x) = -(x + 3)^3$

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

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

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

56. $f(x) = x^3 - 6x^2 + 9x$

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

58. $f(x) = x^5 - x^3$

59. $f(x) = 12x^6 - 36x^5 - 48x^4$

60. $f(x) = 7x^5 - 14x^4 - 21x^3$

61. $f(x) = 2x^5 - 6x^4 - 8x^3$

62. $f(x) = -5x^4 + 10x^3 - 5x^2$

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

64. $f(x) = x^3 - x^2 - x + 1$

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

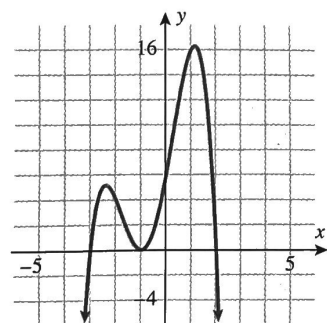
66. $f(x) = (x - 2)^3(x + 1)^3$

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

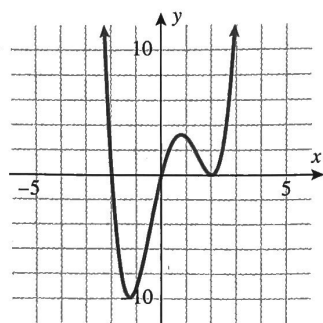
68. $f(x) = -x^3(x - 4)^2(x + 2)^2$

In Exercises 69–72, for each graph given: (a) list each real zero and its smallest possible multiplicity; (b) determine whether the degree of the polynomial is even or odd; (c) determine whether the leading coefficient of the polynomial is positive or negative; (d) find the y -intercept; and (e) write an equation for the polynomial function (assume the least degree possible).

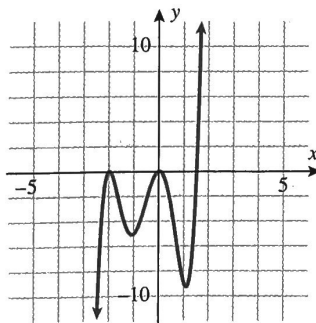
69.



70.



71.



72.

