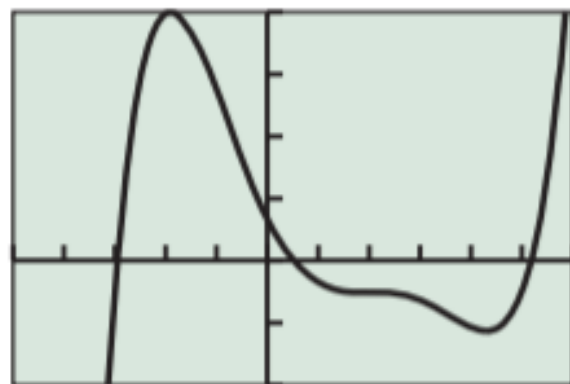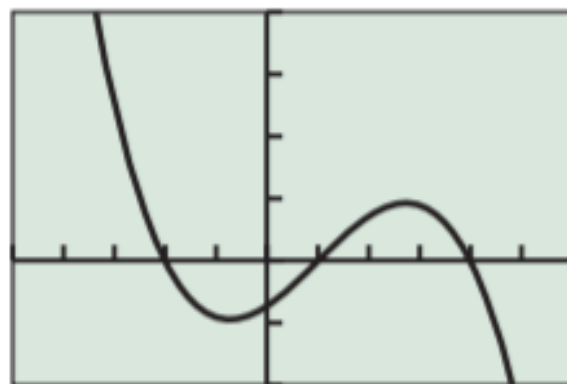In Exercises 9–12, match the polynomial function with its graph. Explain your choice. Do not use a graphing calculator.
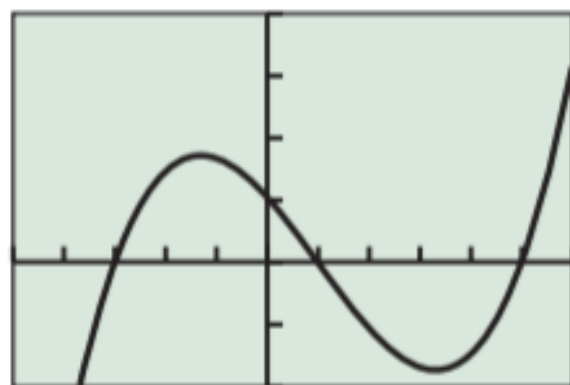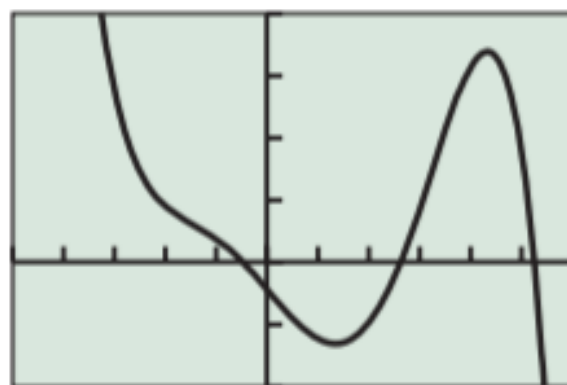
[−5, 6] by [−200, 400]

(a)

[−5, 6] by [−200, 400]

(b)

[−5, 6] by [−200, 400]

(c)

[−5, 6] by [−200, 400]

(d)

9. $f(x) = 7x^3 - 21x^2 - 91x + 104$

10. $f(x) = -9x^3 + 27x^2 + 54x - 73$

11. $f(x) = x^5 - 8x^4 + 9x^3 + 58x^2 - 164x + 69$

12. $f(x) = -x^5 + 3x^4 + 16x^3 - 2x^2 - 95x - 44$

In Exercises 17–24, graph the function in a viewing window that shows all of its extrema and x-intercepts. Describe the end behavior using limits.

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

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

24. $f(x) = -3x^4 - 5x^3 + 15x^2 - 5x + 19$

In Exercises 25–28, describe the end behavior of the polynomial function using $\lim\limits_{x \to \infty} f(x)$ and $\lim\limits_{x \to -\infty} f(x)$.

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

26. $f(x) = -x^3 + 7x^2 - 4x + 3$

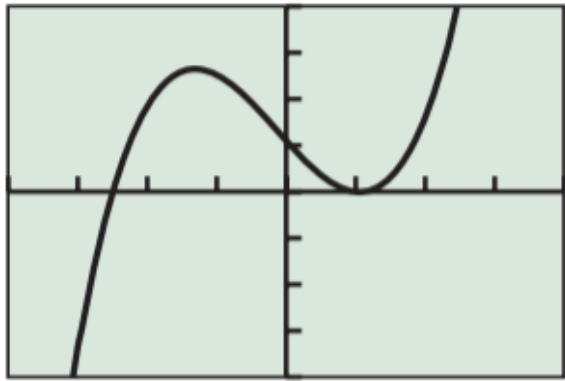**27.** $f(x) = 7x^2 - x^3 + 3x - 4$

28. $f(x) = x^3 - x^4 + 3x^2 - 2x + 7$

$$\lim_{x \to \infty} f(x) = \boxed{?} \qquad \lim_{x \to -\infty} f(x) = \boxed{?}$$
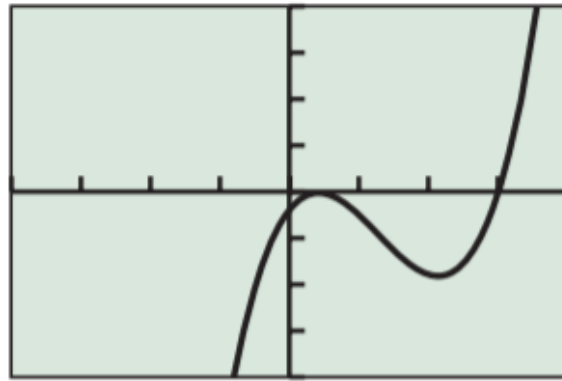
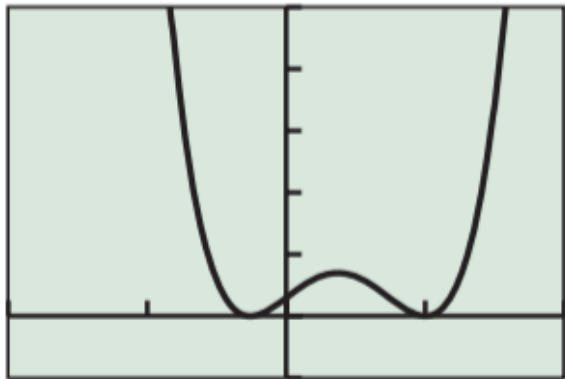In Exercises 29–32, match the polynomial function with its graph. Approximate all of the real zeros of the function.
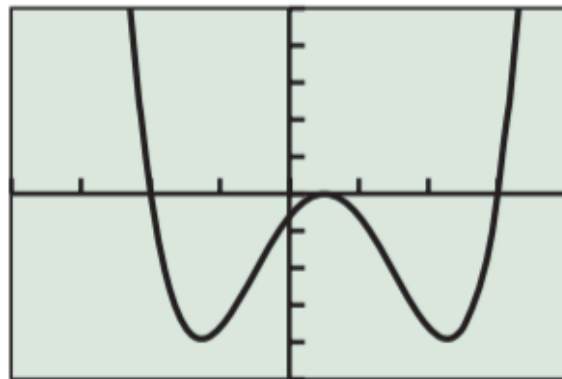

[–4, 4] by [–200, 200]

(a)

[–4, 4] by [–200, 200]

(b)

[–2, 2] by [–10, 50]

(c)

[–4, 4] by [–50, 50]

(d)

29. $f(x) = 20x^3 + 8x^2 - 83x + 55$

30. $f(x) = 35x^3 - 134x^2 + 93x - 18$

31. $f(x) = 44x^4 - 65x^3 + x^2 + 17x + 3$

32. $f(x) = 4x^4 - 8x^3 - 19x^2 + 23x - 6$

In Exercises 39–42, state the degree and list the zeros of the polynomial function. State the multiplicity of each zero and whether the graph crosses the *x*-axis at the corresponding *x*-intercept. Then sketch the graph of the polynomial function by hand.

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

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

59. Use quartic regression to fit a curve through the five points given in the table.

x	3	4	5	6	8
y	-7	-4	-11	8	3

66. Volume of a Box Dixie Packaging Co. has contracted to manufacture a box with no top that is to be made by removing squares of width x from the corners of a 15-in. by 60-in. piece of cardboard.

(a) Show that the volume of the box

(b) Determine x so that the volume of the box is at least 450 in.^{3}