EXAMPLE 2
on p. 380
for Exs. 10–19

FINDING ZEROS **Find all zeros of the polynomial function.**

10. $f(x) = x^4 - 6x^3 + 7x^2 + 6x - 8$

11. $f(x) = x^4 + 5x^3 - 7x^2 - 29x + 30$

12. $g(x) = x^4 - 9x^2 - 4x + 12$

13. $h(x) = x^3 + 5x^2 - 4x - 20$

14. $f(x) = x^4 + 15x^2 - 16$

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

16. $h(x) = x^4 + 4x^3 + 7x^2 + 16x + 12$

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

18. $g(x) = 4x^4 + 4x^3 - 11x^2 - 12x - 3$

19. $h(x) = 2x^4 + 13x^3 + 19x^2 - 10x - 24$

EXAMPLE 3
on p. 381
for Exs. 20–32

WRITING POLYNOMIAL FUNCTIONS **Write a polynomial function *f* of least degree that has rational coefficients, a leading coefficient of 1, and the given zeros.**

20. 1, 2, 3

21. −2, 1, 3

22. −5, −1, 2

23. −3, 1, 6

24. $2, -i, i$

25. $3i, 2 - i$

26. $-1, 2, -3i$

27. $5, 5, 4 + i$

28. $4, -\sqrt{5}, \sqrt{5}$

29. $-4, 1, 2 - \sqrt{6}$

30. $-2, -1, 2, 3, \sqrt{11}$

31. $3, 4 + 2i, 1 + \sqrt{7}$

32. **ERROR ANALYSIS** *Describe* and correct the error in writing a polynomial function with rational coefficients and zeros 2 and $1 + i$.

$$f(x) = (x - 2)[x - (1 + i)]$$
$$= x(x - 1 - i) - 2(x - 1 - i)$$
$$= x^2 - x - ix - 2x + 2 + 2i$$
$$= x^2 - (3 + i)x + (2 + 2i)$$

33. **OPEN-ENDED MATH** Write a polynomial function of degree 5 with zeros 1, 2, and $-i$.

EXAMPLE 4
on p. 382
for Exs. 34–41

CLASSIFYING ZEROS **Determine the possible numbers of positive real zeros, negative real zeros, and imaginary zeros for the function.**

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

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

36. $g(x) = x^3 - 4x^2 + 8x + 7$

37. $h(x) = x^5 - 2x^3 - x^2 + 6x + 5$

38. $h(x) = x^5 - 3x^3 + 8x - 10$

39. $f(x) = x^5 + 7x^4 - 4x^3 - 3x^2 + 9x - 15$

40. $g(x) = x^6 + x^5 - 3x^4 + x^3 + 5x^2 + 9x - 18$

41. $f(x) = x^7 + 4x^4 - 10x + 25$

EXAMPLE 5
on p. 382
for Exs. 42–49

APPROXIMATING ZEROS **Use a graphing calculator to graph the function. Then use the *zero* (or *root*) feature to approximate the real zeros of the function.**

42. $f(x) = x^3 - x^2 - 8x + 5$

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

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

45. $h(x) = x^4 - 5x - 3$

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

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

48. $f(x) = 2x^6 + x^4 + 31x^2 - 35$

49. $g(x) = x^5 - 16x^3 - 3x^2 + 42x + 30$

50. **REASONING** Two zeros of $f(x) = x^3 - 6x^2 - 16x + 96$ are 4 and −4. *Explain* why the third zero must also be a real number.

51. **SHORT RESPONSE** *Describe* the possible numbers of positive real, negative real, and imaginary zeros for a cubic function with rational coefficients.

52. **MULTIPLE CHOICE** Which is *not* a possible classification of the zeros of $f(x) = x^5 - 4x^3 + 6x^2 + 12x - 6$ according to Descartes' rule of signs?

Ⓐ 3 positive real zeros, 2 negative real zeros, and 0 imaginary zeros

Ⓑ 3 positive real zeros, 0 negative real zeros, and 2 imaginary zeros

Ⓒ 1 positive real zero, 4 negative real zeros, and 0 imaginary zeros

Ⓓ 1 positive real zero, 2 negative real zeros, and 2 imaginary zeros

○ = WORKED-OUT SOLUTIONS on p. WS1
★ = TAKS PRACTICE AND REASONING