GUIDED PRACTICE

Vocabulary Check ✓

1. Explain what a local maximum of a function is.

Concept Check ✓

2. Let f be a fourth-degree polynomial function with these zeros: 6, -2, $2i$, and $-2i$.
   a. How many distinct linear factors does $f(x)$ have?
   b. How many distinct solutions does $f(x) = 0$ have?
   c. What are the x-intercepts of the graph of f?
3. Let f be a fifth-degree polynomial function with five distinct real zeros. How many turning points does the graph of f have?

Skill Check ✓

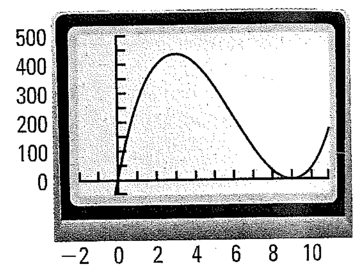
Graph the function.

4. $f(x) = (x - 1)(x + 3)^2$
5. $f(x) = (x - 1)(x + 1)(x - 3)$
6. $f(x) = \frac{1}{8}(x + 1)(x - 1)(x - 3)$
7. $f(x) = \frac{1}{5}(x - 3)^2(x + 1)^2$

Use a graphing calculator to graph the function. Identify the x-intercepts and the points where the local maximums and local minimums occur.

8. $f(x) = 3x^4 - 5x^2 + 2x + 1$
9. $f(x) = x^3 - 3x^2 + x + 1$
10. $f(x) = -2x^3 + x^2 + 4x$
11. $f(x) = x^5 + x^4 - 4x^3 - 3x^2 + 5x$
12. **MANUFACTURING** In Example 3, suppose you used a piece of cardboard that is 18 inches by 18 inches. Then the volume of the box would be given by this function:

$$V = 4x^3 - 72x^2 + 324x$$



Using a graphing calculator, you would obtain the graph shown at the right.

   a. What is the domain of the volume function? Explain.
   b. Use the graph to estimate the length of the cut that will maximize the volume of the box.
   c. Estimate the maximum volume the box can have.

PRACTICE AND APPLICATIONS

STUDENT HELP

Extra Practice to help you master skills is on p. 948.

GRAPHING POLYNOMIAL FUNCTIONS **Graph the function.**

13. $f(x) = (x - 1)^3(x + 1)$
14. $f(x) = \frac{1}{10}(x + 3)(x - 1)(x - 4)$
15. $f(x) = \frac{1}{8}(x + 4)(x + 2)(x - 3)$
16. $f(x) = 2(x + 2)^2(x + 4)^2$
17. $f(x) = 5(x - 1)(x - 2)(x - 3)$
18. $f(x) = \frac{1}{12}(x + 4)(x - 3)(x + 1)^2$
19. $f(x) = (x + 1)(x^2 - 3x + 3)$
20. $f(x) = (x + 2)(2x^2 - 2x + 1)$
21. $f(x) = (x - 2)(x^2 + x + 1)$
22. $f(x) = (x - 3)(x^2 - x + 1)$

STUDENT HELP

HOMEWORK HELP
Example 1: Exs. 13–22
Example 2: Exs. 23–34
Example 3: Exs. 35–40

ANALYZING GRAPHS Estimate the coordinates of each turning point and state whether each corresponds to a local maximum or a local minimum. Then list all the real zeros and determine the least degree that the function can have.

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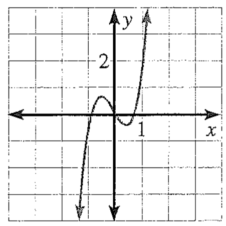

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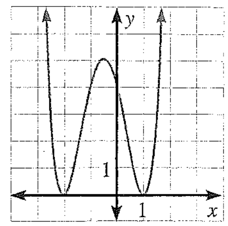

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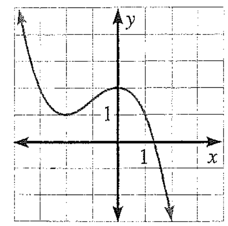

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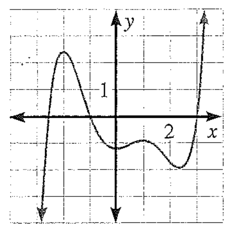

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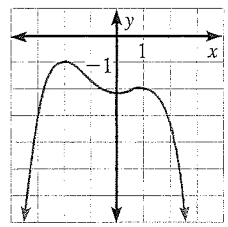

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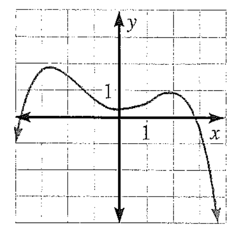


USING GRAPHS Use a graphing calculator to graph the polynomial function. Identify the *x*-intercepts and the points where the local maximums and local minimums occur.

29. $f(x) = 3x^3 - 9x + 1$

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

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

32. $f(x) = x^5 - 6x^3 + 9x$

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

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

35. SWIMMING The polynomial function

$$S = -241t^7 + 1062t^6 - 1871t^5 + 1647t^4 - 737t^3 + 144t^2 - 2.432t$$

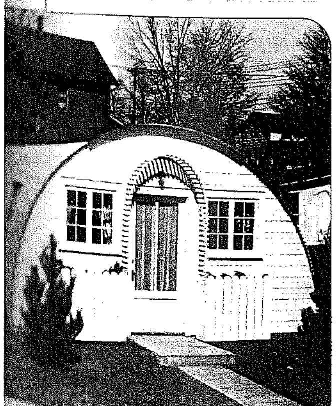
models the speed S (in meters per second) of a swimmer doing the breast stroke during one complete stroke, where t is the number of seconds since the start of the stroke. Graph the function. At what time is the swimmer going the fastest?

36. FOOD The average amount of oranges (in pounds) eaten per person each year in the United States from 1991 to 1996 can be modeled by

$$f(x) = 0.298x^3 - 2.73x^2 + 7.05x + 8.45$$

where x is the number of years since 1991. Graph the function and identify any turning points on the interval $0 \le x \le 5$. What real-life meaning do these points have?

FOCUS ON APPLICATIONS



QUONSET HUTS were invented during World War II. They were temporary structures that could be assembled quickly and easily. After the war they were sold as homes for about $1000 each.

APPLICATION LINK
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QUONSET HUTS In Exercises 37–39, use the following information.
A quonset hut is a dwelling shaped like half a cylinder. Suppose you have 600 square feet of material with which to build a quonset hut.

37. The formula for surface area is $S = \pi r^2 + \pi rl$ where r is the radius of the semicircle and l is the length of the hut. Substitute 600 for S and solve for l.

38. The formula for the volume of the hut is $V = \frac{1}{2}\pi r^2 l$. Write an equation for the volume V of the quonset hut as a polynomial function of r by substituting the expression for l from Exercise 37 into the volume formula.

39. Use the function you wrote in Exercise 38 to find the maximum volume of a quonset hut with a surface area of 600 square feet. What are the hut's dimensions?