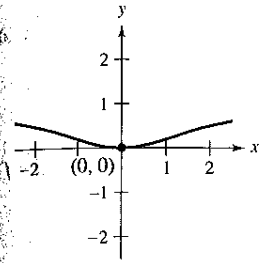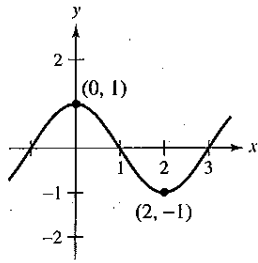# EXERCISES FOR SECTION 3.1

In Exercises 1–6, find the value of the derivative (if it exists) at each indicated extremum.
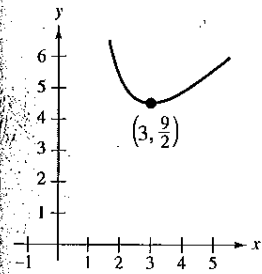
1. $f(x) = \dfrac{x^2}{x^2 + 4}$
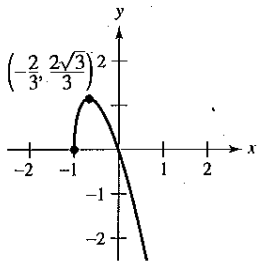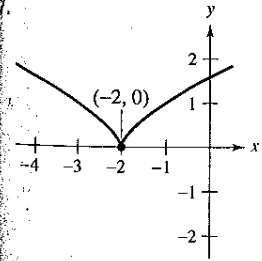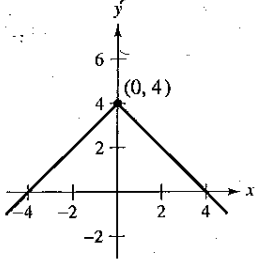

2. $f(x) = \cos \dfrac{\pi x}{2}$

3. $f(x) = x + \dfrac{27}{2x^2}$
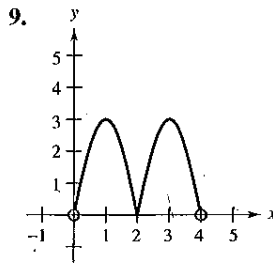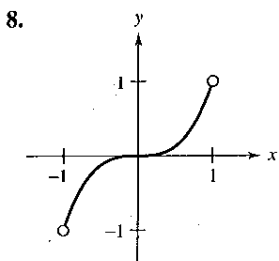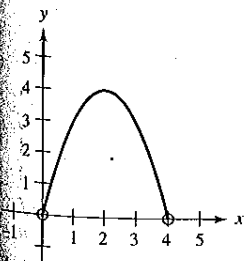

4. $f(x) = -3x\sqrt{x + 1}$

5. $f(x) = (x + 2)^{2/3}$

6. $f(x) = 4 - |x|$

In Exercises 7–10, approximate the critical numbers of the function shown in the graph. Determine whether the function has a relative maximum, relative minimum, absolute maximum, absolute minimum, or none of these at each critical number on the interval shown.

7.

8.

9.

10.
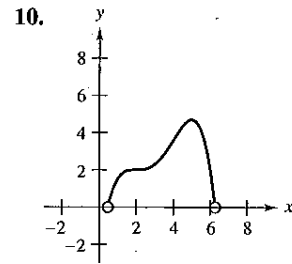
In Exercises 11–16, find any critical numbers of the function.

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

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

13. $g(t) = t\sqrt{4 - t},\ t < 3$

14. $f(x) = \dfrac{4x}{x^2 + 1}$

15. $h(x) = \sin^2 x + \cos x$
    $0 < x < 2\pi$

16. $f(\theta) = 2 \sec \theta + \tan \theta$
    $0 < \theta < 2\pi$

In Exercises 17–32, locate the absolute extrema of the function on the closed interval.

17. $f(x) = 2(3 - x),\ [-1, 2]$

18. $f(x) = \dfrac{2x + 5}{3},\ [0, 5]$

19. $f(x) = -x^2 + 3x,\ [0, 3]$

20. $f(x) = x^2 + 2x - 4,\ [-1, 1]$

21. $f(x) = x^3 - \dfrac{3}{2}x^2,\ [-1, 2]$

22. $f(x) = x^3 - 12x,\ [0, 4]$

23. $y = 3x^{2/3} - 2x,\ [-1, 1]$

24. $g(x) = \sqrt[3]{x},\ [-1, 1]$

25. $g(t) = \dfrac{t^2}{t^2 + 3},\ [-1, 1]$

26. $y = 3 - |t - 3|,\ [-1, 5]$

27. $h(s) = \dfrac{1}{s - 2},\ [0, 1]$

28. $h(t) = \dfrac{t}{t - 2},\ [3, 5]$

29. $f(x) = \cos \pi x,\ \left[0, \dfrac{1}{6}\right]$

30. $g(x) = \sec x,\ \left[-\dfrac{\pi}{6}, \dfrac{\pi}{3}\right]$

31. $y = \dfrac{4}{x} + \tan\left(\dfrac{\pi x}{8}\right),\ [1, 2]$

32. $y = x^2 - 2 - \cos x,\ [-1, 3]$

In Exercises 33–36, locate the absolute extrema of the function (if any exist) over the indicated intervals.

33. $f(x) = 2x - 3$
    (a) $[0, 2]$ (b) $[0, 2)$
    (c) $(0, 2]$ (d) $(0, 2)$

34. $f(x) = 5 - x$
    (a) $[1, 4]$ (b) $[1, 4)$
    (c) $(1, 4]$ (d) $(1, 4)$