

3-22 ■ Differentiate the function.

3.  $f(x) = 5x - 1$       4.  $F(x) = -4x^{10}$   
 5.  $f(x) = 9x^4 - 3x^2 + 8$   
 6.  $g(x) = 5x^8 - 2x^5 + 6$   
 7.  $y = x^{-2/5}$       8.  $y = 5e^x + 3$   
 9.  $G(x) = \sqrt{x} - 2e^x$       10.  $R(t) = 5t^{-3/5}$   
 11.  $V(r) = \frac{4}{3}\pi r^3$       12.  $R(x) = \frac{\sqrt{10}}{x^7}$   
 13.  $F(x) = (16x)^3$       14.  $y = \sqrt{x}(x - 1)$   
 15.  $y = 4\pi^2$       16.  $H(s) = (s/2)^5$   
 17.  $y = \frac{x^2 + 4x + 3}{\sqrt{x}}$       18.  $y = \frac{x^2 - 2\sqrt{x}}{x}$   
 19.  $v = t^2 - \frac{1}{\sqrt[4]{t^3}}$       20.  $y = ae^v + \frac{b}{v} + \frac{c}{v^2}$   
 21.  $z = \frac{A}{y^{10}} + Be^y$       22.  $u = \sqrt[3]{t^2} + 2\sqrt{t^3}$

23-28 ■ Find  $f'(x)$ . Compare the graphs of  $f$  and  $f'$  and use them to explain why your answer is reasonable.

23.  $f(x) = 2x^2 - x^4$   
 24.  $f(x) = 3x^5 - 20x^3 + 50x$   
 25.  $f(x) = 3x^{15} - 5x^3 + 3$       26.  $f(x) = x + \frac{1}{x}$   
 27.  $f(x) = x - 3x^{1/3}$       28.  $f(x) = x^2 + 2e^x$

29. (a) By zooming in on the graph of  $f(x) = x^{2/5}$ , estimate the value of  $f'(2)$ .

(b) Use the Power Rule to find the exact value of  $f'(2)$  and compare with your estimate in part (a).

30. (a) By zooming in on the graph of  $f(x) = x^2 - 2e^x$ , estimate the value of  $f'(1)$ .

(b) Find the exact value of  $f'(1)$  and compare with your estimate in part (a).

31-34 ■ Find an equation of the tangent line to the curve at the given point. Illustrate by graphing the curve and the tangent line on the same screen.

31.  $y = x + \frac{4}{x}$ , (2, 4)      32.  $y = x^{3/2}$ , (4, 32)  
 33.  $y = x + \sqrt{x}$ , (1, 2)      34.  $y = x^2 + 2e^x$ , (0, 2)

35. (a) Use a graphing calculator or computer to graph the function  $f(x) = x^4 - 3x^3 - 6x^2 + 7x + 30$  in the viewing rectangle  $[-3, 5]$  by  $[-10, 50]$ .

(b) Using the graph in part (a) to estimate slopes, make a rough sketch, by hand, of the graph of  $f'$ . (See Example 1 in Section 2.8.)

(c) Calculate  $f'(x)$  and use this expression, with a graphing device, to graph  $f'$ . Compare with your sketch in part (b).

36. (a) Use a graphing calculator or computer to graph the function  $g(x) = e^x - 3x^2$  in the viewing rectangle  $[-1, 4]$  by  $[-8, 8]$ .

(b) Using the graph in part (a) to estimate slopes, make a rough sketch, by hand, of the graph of  $g'$ . (See Example 1 in Section 2.8.)

(c) Calculate  $g'(x)$  and use this expression, with a graphing device, to graph  $g'$ . Compare with your sketch in part (b).

37-38 ■ Find the first and second derivatives of the function.

37.  $f(x) = x^4 - 3x^3 + 16x$

38.  $G(r) = \sqrt{r} + \sqrt[3]{r}$

39-40 ■ Find the first and second derivatives of the function.

Check to see that your answers are reasonable by comparing the graphs of  $f$ ,  $f'$ , and  $f''$ .

39.  $f(x) = 2x - 5x^{3/4}$

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

41. The equation of motion of a particle is  $s = t^3 - 3t$ , where  $s$  is in meters and  $t$  is in seconds. Find

- (a) the velocity and acceleration as functions of  $t$ ,  
 (b) the acceleration after 2 s, and  
 (c) the acceleration when the velocity is 0.

42. The equation of motion of a particle is  $s = 2t^3 - 7t^2 + 4t + 1$ , where  $s$  is in meters and  $t$  is in seconds.

- (a) Find the velocity and acceleration as functions of  $t$ .  
 (b) Find the acceleration after 1 s.  
 (c) Graph the position, velocity, and acceleration functions on the same screen.

43. On what interval is the function  $f(x) = 1 + 2e^x - 3x$  increasing?

44. On what interval is the function  $f(x) = x^3 - 4x^2 + 5x$  concave upward?

45. Find the points on the curve  $y = x^3 - x^2 - x + 1$  where the tangent is horizontal.

46. For what values of  $x$  does the graph of  $f(x) = 2x^3 - 3x^2 - 6x + 87$  have a horizontal tangent?

47. Show that the curve  $y = 6x^3 + 5x - 3$  has no tangent line with slope 4.

# SECTION 3.1