**MATCHED PROBLEM 6** Find

(A) $\frac{d}{dx}\ln(x^3 + 2x)$ (B) $\frac{d}{dx}e^{3x^2+2}$ (C) $\frac{d}{dx}(2 + e^{-x^2})^4$

*Answers to Matched Problems*

1. $f[g(x)] = 2e^x$, $g[f(u)] = e^{2u}$
2. (A) $f(u) = 50e^u$, $u = -2x$ (B) $f(u) = \sqrt[3]{u}$, $u = 1 + x^3$
   [*Note:* There are other correct answers.]
3. (A) $15(5x + 2)^2$
   (B) $20x^3(x^4 - 5)^4$
   (C) $-4t/(t^2 + 4)^3$
   (D) $-1/(2\sqrt{4 - w})$
4. (A) $\frac{dy}{dx} = -5u^{-4}, \frac{du}{dx} = 6x^2, \frac{dy}{dx} = -30x^2(2x^3 + 4)^{-6}$
   (B) $\frac{dy}{du} = e^u, \frac{du}{dx} = 12x^3, \frac{dy}{dx} = 12x^3e^{3x^4+6}$
   (C) $\frac{dy}{du} = \frac{1}{u}, \frac{du}{dx} = 2x + 9, \frac{dy}{dx} = \frac{2x + 9}{x^2 + 9x + 4}$
5. $\frac{3e^x[\ln(1 + e^x)]^2}{1 + e^x}$
6. (A) $\frac{3x^2 + 2}{x^3 + 2x}$ (B) $6xe^{3x^2+2}$ (C) $-8xe^{-x^2}(2 + e^{-x^2})^3$

## Exercise 11-4

*For many of the problems in this exercise set, the answers in the back of the book include both an unsimplified form and a simplified form. When checking your work, first check that you applied the rules correctly, and then check that you performed the algebraic simplification correctly.*

A *In Problems 1–4, find f[g(x)].*

1. $f(u) = u^3$; $g(x) = 3x^2 + 2$
2. $f(u) = u^4$; $g(x) = 1 - 4x^3$
3. $f(u) = e^u$; $g(x) = -x^2$
4. $g(u) = e^u$; $g(x) = 3x^3$

*In Problems 5–8, write each composite function in the form $y = f(u)$ and $u = g(x)$.*

5. $y = (3x^2 - x + 5)^4$
6. $y = (2x^3 + x + 3)^5$
7. $y = e^{1+x+x^2}$
8. $y = e^{x^4+2x^2+5}$

*In Problems 9–16, replace the ? with an expression that will make the indicated equation valid.*

9. $\frac{d}{dx}(3x + 4)^4 = 4(3x + 4)^3$ ?
10. $\frac{d}{dx}(5 - 2x)^6 = 6(5 - 2x)^5$ ?
11. $\frac{d}{dx}(4 - 2x^2)^3 = 3(4 - 2x^2)^2$ ?
12. $\frac{d}{dx}(3x^2 + 7)^5 = 5(3x^2 + 7)^4$ ?
13. $\frac{d}{dx}e^{x^2+1} = e^{x^2+1}$ ?
14. $\frac{d}{dx}e^{4x-2} = e^{4x-2}$ ?
15. $\frac{d}{dx}\ln(x^4 + 1) = \frac{1}{x^4 + 1}$ ?
16. $\frac{d}{dx}\ln(x - x^3) = \frac{1}{x - x^3}$ ?

*In Problems 17–36, find f′(x) and simplify.*

17. $f(x) = (2x + 5)^3$
18. $f(x) = (3x - 7)^5$
19. $f(x) = (5 - 2x)^4$
20. $f(x) = (9 - 5x)^2$
21. $f(x) = (4 + 0.2x)^5$
22. $f(x) = (6 - 0.5x)^4$
23. $f(x) = (3x^2 + 5)^5$
24. $f(x) = (5x^2 - 3)^6$
25. $f(x) = e^{5x}$
26. $f(x) = 6e^{-2x}$
27. $f(x) = 3e^{-6x}$
28. $f(x) = e^{x^2+3x+1}$
29. $f(x) = (2x - 5)^{1/2}$
30. $f(x) = (4x + 3)^{1/2}$
31. $f(x) = (x^4 + 1)^{-2}$
32. $f(x) = (x^5 + 2)^{-3}$
33. $f(x) = 3\ln(1 + x^2)$
34. $f(x) = 2\ln(x^2 - 3x + 4)$
35. $f(x) = (1 + \ln x)^3$
36. $f(x) = (x - 2\ln x)^4$

*In Problems 37–42, find f′(x) and the equation of the line tangent to the graph of f at the indicated value of x. Find the value(s) of x where the tangent line is horizontal.*

37. $f(x) = (2x - 1)^3$; $x = 1$
38. $f(x) = (3x - 1)^4$; $x = 1$

39. $f(x) = (4x - 3)^{1/2}$; $x = 3$

40. $f(x) = (2x + 8)^{1/2}$; $x = 4$

41. $f(x) = 5e^{x^2-4x+1}$; $x = 0$

42. $f(x) = \ln(1 - x^2 + 2x^4)$; $x = 1$

*In Problems 43–62, find the indicated derivative and simplify.*

43. $y'$ if $y = 3(x^2 - 2)^4$

44. $y'$ if $y = 2(x^3 + 6)^5$

45. $\dfrac{d}{dt}2(t^2 + 3t)^{-3}$

46. $\dfrac{d}{dt}3(t^3 + t^2)^{-2}$

47. $\dfrac{dh}{dw}$ if $h(w) = \sqrt{w^2 + 8}$

48. $\dfrac{dg}{dw}$ if $g(w) = \sqrt[3]{3w - 7}$

49. $g'(x)$ if $g(x) = 4xe^{3x}$

50. $h'(x)$ if $h(x) = \dfrac{e^{2x}}{x^2 + 9}$

51. $\dfrac{d}{dx}\dfrac{\ln(1 + x)}{x^3}$

52. $\dfrac{d}{dx}[x^4 \ln(1 + x^4)]$

53. $F'(t)$ if $F(t) = (e^{t^2+1})^3$

54. $G'(t)$ if $G(t) = (1 - e^{2t})^2$

55. $y'$ if $y = \ln(x^2 + 3)^{3/2}$

56. $y'$ if $y = [\ln(x^2 + 3)]^{3/2}$

57. $\dfrac{d}{dw}\dfrac{1}{(w^3 + 4)^5}$

58. $\dfrac{d}{dw}\dfrac{1}{(w^2 - 2)^6}$

59. $\dfrac{dy}{dx}$ if $y = (3\sqrt{x} - 1)^5$

60. $\dfrac{dy}{dx}$ if $y = \left(\dfrac{1}{x^2} - 5\right)^{-2}$

61. $f'(t)$ if $f(t) = \dfrac{4}{\sqrt{t^2 - 3t}}$

62. $g'(t)$ if $g(t) = \dfrac{3}{\sqrt[3]{t - t^2}}$

*In Problems 63–68, find $f'(x)$ and find the equation of the line tangent to the graph of $f$ at the indicated value of $x$.*

63. $f(x) = x(4 - x)^3$; $x = 2$

64. $f(x) = x^2(1 - x)^4$; $x = 2$

65. $f(x) = \dfrac{x}{(2x - 5)^3}$; $x = 3$

66. $f(x) = \dfrac{x^4}{(3x - 8)^2}$; $x = 4$

67. $f(x) = \sqrt{\ln x}$; $x = e$

68. $f(x) = e^{\sqrt{x}}$; $x = 1$

*In Problems 69–74, find $f'(x)$ and find the value(s) of $x$ where the tangent line is horizontal.*

69. $f(x) = x^2(x - 5)^3$

70. $f(x) = x^3(x - 7)^4$

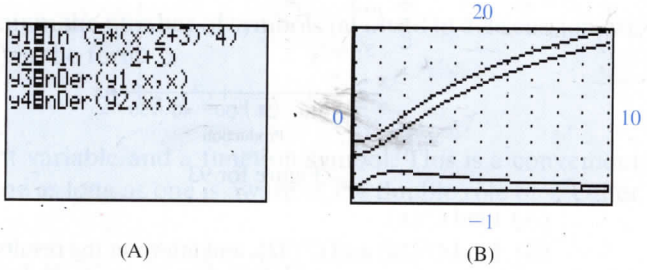
71. $f(x) = \dfrac{x}{(2x + 5)^2}$

72. $f(x) = \dfrac{x - 1}{(x - 3)^3}$

73. $f(x) = \sqrt{x^2 - 8x + 20}$

74. $f(x) = \sqrt{x^2 + 4x + 5}$

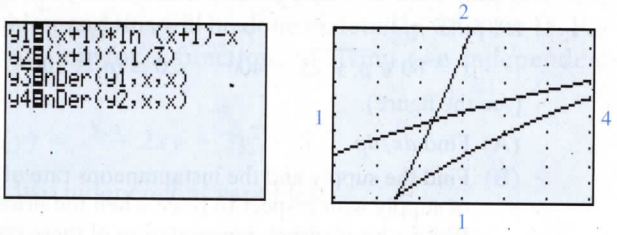
75. Suppose a student reasons that the functions $f(x) = \ln[5(x^2 + 3)^4]$ and $g(x) = 4\ln(x^2 + 3)$ must have the same derivative, since he has entered $f(x)$, $g(x)$, $f'(x)$, and $g'(x)$ into a graphing calculator, but only three graphs appear (see the figure). Is his reasoning correct? Are $f'(x)$ and $g'(x)$ the same function? Explain.




(A) (B)

Figure for 75

76. Suppose a student reasons that the functions $f(x) = (x + 1)\ln(x + 1) - x$ and $g(x) = (x + 1)^{1/3}$ must have the same derivative, since she has entered $f(x)$, $g(x)$, $f'(x)$, and $g'(x)$ into a graphing calculator, but only three graphs appear (see the figure). Is her reasoning correct? Are $f'(x)$ and $g'(x)$ the same function? Explain.




(A) (B)

Figure for 76

*In Problems 77–92, find each derivative and simplify.*

77. $\dfrac{d}{dx}[3x(x^2 + 1)^3]$

78. $\dfrac{d}{dx}[2x^2(x^3 - 3)^4]$

79. $\dfrac{d}{dx}\dfrac{(x^3 - 7)^4}{2x^3}$

80. $\dfrac{d}{dx}\dfrac{3x^2}{(x^2 + 5)^3}$

81. $\dfrac{d}{dx}\log_2(3x^2 - 1)$

82. $\dfrac{d}{dx}\log(x^3 - 1)$

83. $\dfrac{d}{dx}10^{x^2+x}$

84. $\dfrac{d}{dx}8^{1-2x^2}$

85. $\dfrac{d}{dx}\log_3(4x^3 + 5x + 7)$

86. $\dfrac{d}{dx}\log_5(5^{x^2-1})$

87. $\dfrac{d}{dx}2^{x^3-x^2+4x+1}$

88. $\dfrac{d}{dx}10^{\ln x}$

89. $\dfrac{d}{dx}\dfrac{2x}{\sqrt{x - 3}}$

90. $\dfrac{d}{dx}\dfrac{x^2}{\sqrt{x^2 + 1}}$

91. $\dfrac{d}{dx}\sqrt{(2x - 1)^3(x^2 + 3)^4}$

92. $\dfrac{d}{dx}\sqrt{\dfrac{4x + 1}{2x^2 + 1}}$