# FOCUS ON PRACTICE

## DIFFERENTIATION

Find derivatives for the functions in Problems 1–114. Assume $a$, $b$, $c$, and $k$ are constants.

1. $f(t) = 3t^2 - 4t + 1$
2. $y = 17x + 24x^{1/2}$
3. $g(x) = -\frac{1}{2}(x^5 + 2x - 9)$
4. $g(t) = \dfrac{t^3 + k}{t}$
5. $f(x) = 5x^4 + \dfrac{1}{x^2}$
6. $z = \dfrac{t^2 + 3t + 1}{t + 1}$
7. $y = \dfrac{e^{2x}}{x^2 + 1}$
8. $f(x) = \dfrac{x^2 + 3x + 2}{x + 1}$
9. $y = \left(\dfrac{x^2 + 2}{3}\right)^2$
10. $g(\theta) = \sin^2(2\theta) - \pi\theta$
11. $g(x) = \sin(2 - 3x)$.
12. $R(x) = 10 - 3\cos(\pi x)$
13. $f(z) = \dfrac{z^2 + 1}{3z}$
14. $q(r) = \dfrac{3r}{5r + 2}$
15. $h(z) = \sqrt{\dfrac{\sin(2z)}{\cos(2z)}}$
16. $y = x \ln x - x + 2$
17. $j(x) = \ln(e^{ax} + b)$
18. $y = 2x(\ln x + \ln 2) - 2x + e$
19. $g(\theta) = \sin(\tan\theta)$
20. $w(x) = \tan(x^2)$
21. $f(x) = \sin(\sin x + \cos x)$
22. $j(x) = \cos\left(\sin^{-1} x\right)$
23. $k(\alpha) = \sin^5\alpha\cos^3\alpha$
24. $f(w) = \cos^2 w + \cos(w^2)$
25. $g(t) = \dfrac{4}{3 + \sqrt{t}}$
26. $g(t) = \dfrac{t - 4}{t + 4}$
27. $y = \dfrac{1}{e^{3x} + x^2}$
28. $h(w) = (w^4 - 2w)^5$
29. $q(\theta) = \sqrt{4\theta^2 - \sin^2(2\theta)}$
30. $g(t) = (t\cos t + \tan^3(t^5))^4$
31. $h(w) = w^3 \ln(10w)$
32. $f(x) = \ln(\sin x + \cos x)$
33. $g(x) = \arcsin(\sin \pi x)$
34. $r(t) = \arcsin(2t)$
35. $w(r) = \sqrt{r^4 + 1}$
36. $h(w) = -2w^{-3} + 3\sqrt{w}$
37. $h(x) = \sqrt{\dfrac{x^2 + 9}{x + 3}}$
38. $f(x) = \sqrt{\dfrac{1 - \sin x}{1 - \cos x}}$
39. $T(u) = \arctan\left(\dfrac{u}{1 + u}\right)$
40. $w = 2^{-4z}\sin(\pi z)$
41. $v(t) = t^2 e^{-ct}$
42. $f(x) = \pi^x + x^\pi$
43. $f(x) = \dfrac{x}{1 + \ln x}$
44. $G(x) = \dfrac{\sin^2 x + 1}{\cos^2 x + 1}$
45. $a(t) = \ln\left(\dfrac{1 - \cos t}{1 + \cos t}\right)^4$
46. $f(x) = e^{\ln(kx)}$
47. $R(\theta) = e^{\sin(3\theta)}$
48. $f(x) = e^\pi + \pi^x$
49. $y = \pi^{(x+2)}$
50. $g(x) = e^{\pi x}$
51. $g(\theta) = e^{\sin\theta}$
52. $f(\theta) = 2^{-\theta}$
53. $f(x) = e^{2x}\left(x^2 + 5^x\right)$
54. $h(x) = 2^{e^{3x}}$
55. $h(t) = \dfrac{4 - t}{4 + t}$
56. $r(y) = \dfrac{y}{\cos y + a}$
57. $h(z) = \left(\dfrac{b}{a + z^2}\right)^4$
58. $p(t) = e^{4t+2}$
59. $h(z) = (\ln 2)^z$
60. $j(x) = \dfrac{x^3}{a} + \dfrac{a}{b}x^2 - cx + k$
61. $f(x) = \cos(\arctan 3x)$
62. $f(x) = (3x^2 + \pi)(e^x - 4)$
63. $g(t) = e^{(1+3t)^2}$
64. $f(z) = \dfrac{z^2 + 1}{\sqrt{z}}$
65. $h(r) = \dfrac{r^2}{2r + 1}$
66. $g(x) = 2x - \dfrac{1}{\sqrt[3]{x}} + 3^x - e$

67. $f(t) = 2te^t - \dfrac{1}{\sqrt{t}}$

68. $w = \dfrac{5-3z}{5+3z}$

69. $g(w) = \dfrac{1}{2^w + e^w}$

70. $f(y) = \ln\left(\ln(2y^3)\right)$

71. $f(x) = \dfrac{x^3}{9}(3\ln x - 1)$

72. $g(x) = x^k + k^x$

73. $r(\theta) = \sin\left((3\theta - \pi)^2\right)$

74. $s(\theta) = \sin^2(3\theta - \pi)$

75. $h(t) = \ln\left(e^{-t} - t\right)$

76. $p(\theta) = \dfrac{\sin(5-\theta)}{\theta^2}$

77. $w(\theta) = \dfrac{\theta}{\sin^2\theta}$

78. $g(x) = \dfrac{x^2 + \sqrt{x} + 1}{x^{3/2}}$

79. $s(x) = \arctan(2 - x)$

80. $r(\theta) = e^{(e^\theta + e^{-\theta})}$

81. $m(n) = \sin(e^n)$

82. $k(\alpha) = e^{\tan(\sin\alpha)}$

83. $g(t) = t\cos(\sqrt{t}e^t)$

84. $f(r) = (\tan 2 + \tan r)^e$

85. $y = e^{-\pi} + \pi^{-e}$

86. $y = \left(x^2 + 5\right)^3\left(3x^3 - 2\right)^2$

87. $h(x) = xe^{\tan x}$

88. $y = e^{2x}\sin^2(3x)$

89. $g(x) = \tan^{-1}(3x^2 + 1)$

90. $y = 2^{\sin x}\cos x$

91. $h(x) = \ln e^{ax}$

92. $k(x) = \ln e^{ax} + \ln b$

93. $f(\theta) = e^{k\theta} - 1$

94. $N(\theta) = \tan(\arctan(k\theta))$

95. $f(t) = e^{-4kt}\sin t$

96. $f(x) = a^{5x}$

97. $f(x) = \dfrac{a^2 - x^2}{a^2 + x^2}$

98. $w(r) = \dfrac{ar^2}{b + r^3}$

99. $f(s) = \dfrac{a^2 - s^2}{\sqrt{a^2 + s^2}}$

100. $h(t) = e^{kt}(\sin at + \cos bt)$

101. $H(t) = (at^2 + b)e^{-ct}$

102. $g(\theta) = \sqrt{a^2 - \sin^2\theta}$

103. $y = \arctan\left(\dfrac{2}{x}\right)$

104. $r(t) = \ln\left(\sin\left(\dfrac{t}{k}\right)\right)$

105. $g(u) = \dfrac{e^{au}}{a^2 + b^2}$

106. $g(w) = \dfrac{5}{(a^2 - w^2)^2}$

107. $y = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$

108. $y = \dfrac{e^{ax} - e^{-ax}}{e^{ax} + e^{-ax}}$

109. $f(x) = (2 - 4x - 3x^2)(6x^e - 3\pi)$

110. $f(t) = (\sin(2t) - \cos(3t))^4$

111. $s(y) = \sqrt[3]{(\cos^2 y + 3 + \sin^2 y)}$

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

113. $h(x) = \left(\dfrac{1}{x} - \dfrac{1}{x^2}\right)\left(2x^3 + 4\right)$

114. $f(z) = \sqrt{5z} + 5\sqrt{z} + \dfrac{5}{\sqrt{z}} - \sqrt{\dfrac{5}{z}} + \sqrt{5}$

115. If $g(2) = 3$ and $g'(2) = -4$, find $f'(2)$ for the following:

(a) $f(x) = x^2 - 4g(x)$ (b) $f(x) = \dfrac{x}{g(x)}$ (c) $f(x) = x^2 g(x)$

(d) $f(x) = (g(x))^2$ (e) $f(x) = x\sin(g(x))$ (f) $f(x) = x^2\ln(g(x))$

116. For parts (a)–(f) of Problem 115, determine the equation of the line tangent to $f$ at $x = 2$.

For Problems 117–122, assume that $y$ is a differentiable function of $x$ and find $dy/dx$.

117. $xy - x - 3y - 4 = 0$

118. $6x^2 + 4y^2 = 36$

119. $ax^2 - by^2 = c^2$

120. $x^2y - 2y + 5 = 0$

121. $x^3 + y^3 - 4x^2y = 0$

122. $\sin(ay) + \cos(bx) = xy$