

Find  $y'$ :

- (1)  $y = 3x^2 \sin(8 + 2x)$  (2)  $y = (5x - 2) \cos(5x)$  (3)  $y = 6x - \frac{5x}{\sin(4x)}$
- (4)  $y = x^2 \sin(2x) - 4x$  (5)  $y = \frac{3x - 1}{\sin(3x)}$  (6)  $y = (2 + \sin(2x))(\sec(2x) + 4)$
- (7)  $y = \frac{\sin(x) + x^2}{4x - \cos(x)}$  (8)  $y = 12x^2 + \cos(3 - x)$  (9)  $y = \sin \left[ (3x - x^2)^2 \right]$
- (10)  $y = \sqrt[3]{\sin(3x) + \cos(3x) + 2}$  (11)  $\cos(3x - y) + 4y + 2x = 15$  (12)  $y \cos(x) + x^2 \cos(y) = \pi^2$
- (13)  $4 \cos(y) + 3x = 6$  (14)  $\cos\left(\frac{y}{x}\right) + x^2 = 4$  (15)  $\sec(xy^2) - y + 6x = 6$
- (16)  $\sin(3y - x) + 2 \cos(3y - 1) = 3$  (17)  $\tan(4x - y) + 2y = 8$  (18)  $\frac{3 \cos(x) - 1}{1 + \cos(y)} = 2 + 3x$
- (19)  $y = \sin^2(6 - 2x) + x^3$  (20)  $y = \sin\left(\frac{x + 1}{2x}\right)$  (21)  $y = 4^{2x} \sin(3x)$
- (22)  $y = 7^{4 \sin(x) + x^2}$  (23)  $y = \tan(3^{3x} - 1)$  (24)  $y = 2^{x+3} \sin(\pi x)$
- (25)  $y = \frac{\sin(4x)}{e^{3x}}$  (26)  $y = 13^{\sin(2x-6)}$  (27)  $3 \tan(y) - e^{2x} + 1 = 0$
- (28)  $4 \tan(3y) - e^{4x} + 1 = 0$  (29)  $y = \log_4(2x + \cos(x))$  (30)  $y = \sin(\log_5(x) + \pi x)$
- (31)  $y = \frac{\cos(x)}{\log_{13}(2x + 1) + 3}$  (32)  $y = \log_2(4 \sin(x) + e^{3x})$  (33)  $y = (4x + 3)^{\tan(3-x)}$
- (34)  $\log_3(2 \tan(x) + 1) = \sin(3y)$  (35)  $y = (4 - 3x) \cot(3x)$  (36)  $y = 5x - \frac{4x}{\sec(2x)}$
- (37)  $y = 3x \cos(2x) - 2x^2$  (38)  $y = \frac{5x - 3}{\cos(4x)}$  (39)  $y = (3 - \cos(3x))(\tan(3x) + 6)$
- (40)  $y = \frac{3x - \sin(x)}{x^2 + \cos(x)}$  (41)  $y = 5x^2 - \sin(1 - x)$  (42)  $y = \cos \left[ (x^3 - 4x)^2 \right]$
- (43)  $y = \sqrt[4]{2 \cos(2x) - \sin(2x) - 1}$  (44)  $\sin(2y - x) + 3y^2 = x + 1$  (45)  $y^2 \cos(y) + x \cos(y) + \pi^2 = 0$
- (46)  $6 \sin(y) - 2x + 2 = 0$  (47)  $\sin(xy) + y^2 = 4$  (48)  $\csc(3y) + \cos(y) - x^2 + 2 = 0$
- (49)  $\sec(2y - x) + 3y = 3x^2 + 1$  (50)  $\frac{\sin(x) + 3}{3 \cos(y) + 1} - 4y = \cos(x) + 1$  (51)  $y = \cos^2(15 - 3x) - 3x^2$
- (52)  $y = \tan\left(\frac{3x}{x - 2}\right)$  (53)  $y = e^{-x} \cos(2x)$  (54)  $y = e^{\sin(x) + x}$
- (55)  $y = \sin(1 - e^{2x})$  (56)  $y = e^{2x+4} \tan(\pi x)$  (57)  $y = \frac{\tan(2x)}{e^{3x}}$
- (58)  $y = e^{-\tan(2-x)}$  (59)  $4 \tan(y) + e^{4x} = 1$  (60)  $5 \sin(x) - e^{3y} + 1 = 0$
- (61)  $y = \ln(3x + \sec(x))$  (62)  $y = \tan(\pi x^2 - \ln(x))$  (63)  $y = \frac{\sin(x)}{4 - \ln(3x + 1)}$

$$\begin{array}{lll}
 (64) y = \ln(3 \tan(x) + e^{5x}) & (65) \ln(3 \sin(x) + 1) = \tan(2y) & (66) y = \ln \left[ \frac{(x^3 + 1)^2 (\tan(x) + 2)^3}{\sqrt{\cos(x) + 2}} \right] \\
 (67) y = \ln \left[ \frac{\sqrt[3]{2x - \cos(x)}}{(\sin(x) + 4)^3 \sqrt{x + 1}} \right] & (68) y = \ln \left[ \frac{\cos^2(x^2 - 1)}{\sqrt{x + 3} (x^2 + 1)^3} \right] & (69) \sin\left(\frac{x}{y}\right) + \cos(xy) + 2y^3 = 17 \\
 (70) \sin(\ln(y)) - \tan(xy) + 3x = 0 & (71) e^{\sin(y)} - \cos\left(\frac{y}{x}\right) + 4x = 3 & (72) e^{y - \sin(x)} + \frac{\cos(y)}{4x + 1} + 3y = 2
 \end{array}$$

Find the higher-order derivatives:

$$\begin{array}{lll}
 (73) \text{ Find } \frac{d^4 y}{dx^4} \text{ if } y = \cos(9 - 3x) & (74) \text{ Find } y''' \text{ if } y = \cos\left(\frac{x}{3}\right) & (75) \text{ Find } \frac{d^2 y}{dx^2} \text{ if } y = \ln(\cos(3x)) \\
 (76) \text{ Find } y'' \text{ if } y = \ln(\sin^3(x)) & (77) \text{ Find } y'' \text{ if } y = e^{\cos(2x) - 1} & (78) \text{ Find } y'' \text{ if } y = 3x \sin(2x) \\
 (79) \text{ Find } \frac{d^2 y}{dx^2} \text{ if } y = \sin(2 \ln(x)) & (80) \text{ Find } y'' \text{ if } y = (2x - 1) \cos(3x) & (81) \text{ Find } y'' \text{ if } y = \frac{\sin(x) + 3}{\sin(x) + 4} \\
 (82) \text{ Find } \frac{d^2 y}{dx^2} \text{ if } y = \ln(\sin(5x)) & (83) \text{ Find } \left. \frac{d^2 y}{dx^2} \right|_{x=0} \text{ if } y = \ln(\cos^2(2x)) & (84) \text{ Find } y''' \text{ if } y = \sin\left(\frac{x}{2}\right)
 \end{array}$$

For the following functions, find  $y'$  using logarithmic differentiation.

$$\begin{array}{lll}
 (85) y = (x + 1)^{2 \cos(x)} & (86) y = (4 + x)^{\sin(4 - x)} & (87) y = \frac{(6x + 1)^2 \sqrt[4]{2x^2 + 1}}{e^{1 - \cos(x)}} \\
 (88) y = \frac{\sin(4x) e^{3 \sin(x)}}{\sqrt[3]{9x + 1}} & (89) y = \frac{\sqrt{\sin(3x) + 1}}{\cos^2(x) \sqrt[3]{x^2 + 1}} & (90) y = \frac{(x + 2) \sqrt{\cos^3(x)}}{(3x + \cos(2x))^4} \\
 (91) y = \frac{(\sin(3x) - \cos(2x))^4}{2 \sec(x) (\tan(x) + 2)^2} & (92) y = \frac{1}{(\sin(3x))^{x + 1}} & (93) y = (x^2 + 2)^{\tan(x)} \\
 (94) y = (\tan(2x) + 3)^{\cos(x)} & (95) y = (\sin(3x) + \cos(x))^{\sqrt{x + 1}} & (96) y = \left( \ln(\cos(x)) + 4 \right)^{\tan(2x)} \\
 (97) y = \frac{\sqrt[3]{3x + 1} e^{\sin(2x)}}{(x^3 + 1)^3} & (98) y = \frac{\cos(2x) \sqrt{4x + 1}}{e^{\sin(3x)}} & (99) y = (\tan(x))^{2x}
 \end{array}$$

## Answers

$$\begin{array}{lll}
 (1) 6x \sin(8 + 2x) + 6x^2 \cos(8 + 2x) & (2) 5 \cos(5x) - (25x - 10) \sin(5x) & (3) 6 - \frac{5 \sin(4x) - 20x \cos(4x)}{\sin^2(4x)} \\
 (4) 2x \sin(2x) + 2x^2 \cos(2x) - 4 & (5) \frac{3 \sin(3x) - (9x - 3) \cos(3x)}{\sin^2(3x)} &
 \end{array}$$

- (6)  $2 \cos(2x)[\sec(2x) + 4] + 2 \sec(2x) \tan(2x)[2 + \sin(2x)]$  (7)  $\frac{2x \cos(x) - (x^2 + 4) \sin(x) + 4x^2 - 1}{(4x - \cos(x))^2}$
- (8)  $24x + \sin(3 - x)$  (9)  $(4x^3 - 18x^2 + 18x) \cos[(3x - x^2)^2]$  (10)  $\frac{3 \cos(3x) - 3 \sin(3x)}{3(\sin(3x) + \cos(3x))^{\frac{2}{3}}}$
- (11)  $\frac{3 \sin(3x - y) - 2}{\sin(3x - y) + 4}$  (12)  $\frac{y \sin(x) - 2x \cos(y)}{\cos(x) - x^2 \sin(y)}$  (13)  $\frac{3}{4 \sin(y)}$  (14)  $\frac{2x^3 + y \sin(\frac{y}{x})}{x \sin(\frac{y}{x})}$  (15)  $\frac{6x + y^2 \sec(xy^2) \tan(xy^2)}{1 - 2xy \sec(xy^2) \tan(xy^2)}$
- (16)  $\frac{\cos(3y - x)}{3 \cos(3y - x) - 6 \sin(3y - 1)}$  (17)  $\frac{4 \sec^2(4x - y)}{\sec^2(4x - y) - 2}$  (18)  $\frac{3 \sin(x) + 3 \cos(y) + 3}{2 \sin(y) + 3x \sin(y)}$
- (19)  $3x^2 - 4 \sin(6 - 2x) \cos(6 - 2x)$  (20)  $\cos\left(\frac{x+1}{2x}\right) \frac{-1}{2x^2}$  (21)  $4^{2x}(2 \ln(4) \sin(3x) + 3 \cos(3x))$
- (22)  $7^{4 \sin(x) + x^2} \ln(7)(2x - 4 \cos(x))$  (23)  $3 \ln(3) 3^{3x} \sec^2(3^{3x} - 1)$  (24)  $2^{x+3}(\ln(2) \sin(\pi x) + \pi \cos(\pi x))$
- (25)  $\frac{4 \cos(4x) - 3 \sin(4x)}{e^{3x}}$  (26)  $2 \ln(13) \cos(2x - 6) 13^{\sin(2x-6)}$  (27)  $\frac{2e^{2x}}{3 \sec^2(y)}$  (28)  $\frac{e^{4x}}{3 \sec^2(y)}$
- (29)  $\frac{2 - \sin(x)}{(2x + \cos(x)) \ln(4)}$  (30)  $\cos(\log_5(x) + \pi x) \left(\frac{1}{x \ln(5)} + \pi\right)$  (31)  $\frac{\frac{2 \cos(x)}{(2x+1) \ln(13)} - \sin(x) (\log_{13}(2x+1) + 3)}{(\log_{13}(2x+1) + 3)^2}$
- (32)  $\frac{4 \cos(x) + 3e^{3x}}{(4 \sin(x) + e^{3x}) \ln(2)}$  (33)  $(4x + 3)^{\tan(3-x)} \left[\frac{4 \tan(3-x)}{4x+3} - \sec^2(3-x) \ln(4x+3)\right]$  (34)  $\frac{2 \sec^2(x)}{3 \ln(3) \cos(3y)(2 \tan(x) + 1)}$
- (35)  $-3 \cot(3x) - 3(4 - 3x) \csc^2(3x)$  (36)  $5 - \frac{4 - 8x \tan(2x)}{\sec(2x)}$  (37)  $3 \cos(2x) - 6x \sin(2x) - 4x$
- (38)  $\frac{5 \cos(4x) + 4(5x - 3) \sin(4x)}{\cos^2(4x)}$  (39)  $3 \sin(3x) + 18 \cos(3x) + 9 \sec^2(3x) - 3 \sec(3x)$
- (40)  $\frac{(3 - \cos(x))(x^2 + \cos(x)) - (3x - \sin(x))(2x - \sin(x))}{(x^2 + \cos(x))^2}$
- (41)  $10x + \cos(1 - x)$  (42)  $-1(x^3 - 4x)(3x^2 - 4) \sin[(x^3 - 4x)^2]$  (43)  $\frac{-4 \sin(2x) - 2 \cos(2x)}{4(2 \cos(2x) - \sin(2x) - 1)^{\frac{3}{4}}}$
- (44)  $\frac{\cos(2y - x) + 1}{2 \cos(2y - x) + 6y}$  (45)  $\frac{-\cos(y)}{2y \cos(y) - y^2 \sin(y) - x \sin(y)}$  (46)  $\frac{2}{6 \cos(y)}$  (47)  $\frac{-y \cos(xy)}{x \cos(xy) + 2y}$
- (48)  $\frac{-2x}{3 \csc(3y) \cot(3y) + \sin(y)}$  (49)  $\frac{6x + \sec(2y - x) \tan(2y - x)}{2 \sec(2y - x) \tan(2y - x) + 3}$  (50)  $\frac{3 \sin(x) \cos(y) + \sin(x) + \cos(x)}{4 + 12 \cos(y) - 12y \sin(y) - 3 \sin(y) - 3 \cos(x) \sin(y)}$
- (51)  $6 \cos(15 - 3x) \sin(15 - 3x) - 6x$  (52)  $\sec^2\left(\frac{3x}{x-2}\right) \frac{-6}{(x-2)^2}$  (53)  $-e^{-x}(\cos(2x) + 2 \sin(2x))$
- (54)  $e^{\sin(x)+x}(\cos(x)+1)$  (55)  $-2e^{2x}(\cos(1-e^{2x}))$  (56)  $e^{2x+4}(2 \tan(\pi x) + \pi \sec^2(\pi x))$  (57)  $\frac{2 \sec^2(2x) - 3 \tan(2x)}{e^{3x}}$

$$(58) \sec^2(2-x)e^{-\tan(2-x)} \quad (59) \frac{-e^{4x}}{\sec^2(y)} \quad (60) \frac{5 \cos(x)}{3e^{3y}} \quad (61) \frac{3 + \sec(x) \tan(x)}{3x + \sec(x)} \quad (62) \sec^2(\pi x^2 - \ln(x)) \left(2\pi x - \frac{1}{x}\right)$$

$$(63) \frac{\cos(x)(4 - \ln(3x+1)) + \sin(x) \frac{3}{3x+1}}{(4 - \ln(3x+1))^2} \quad (64) \frac{3 \sec^2(x) + 5e^{5x}}{3 \tan(x) + e^{5x}} \quad (65) \frac{3 \cos(x)}{2(3 \sin(x) + 1) \sec^2(2y)}$$

$$(66) \frac{6x^2}{x^3 + 1} + \frac{3 \sec^2(x)}{\tan(x)} + \frac{\sin(x)}{2(\cos(x) + 2)} \quad (67) \frac{2 + \sin(x)}{3(2x - \cos(x))} - \frac{3 \cos(x)}{\sin(x) + 4} - \frac{1}{2(x+1)}$$

$$(68) -4 \tan(x^2 - 1) - \frac{1}{3(x+3)} - \frac{6x}{x^2 + 1} \quad (69) \frac{y^3 \sin(xy) + y \cos\left(\frac{x}{y}\right)}{6y^4 - xy^2 \sin(xy) - s \cos\left(\frac{x}{y}\right)} \quad (70) \frac{y^2 \sec^2(xy) - 3y}{\cos(\ln(y)) - xy \sec^2(xy)}$$

$$(71) \frac{y \sin\left(\frac{y}{x}\right) - 4x^2}{x^2 \cos(y) e^{\sin(y)} + x \sin\left(\frac{y}{x}\right)} \quad (72) \frac{\cos(x)e^{y-\sin(x)} + \frac{4 \cos(y)}{(4x+1)^2}}{e^{y-\sin(x)} - \frac{\sin(y)}{4x+1} + 3} \quad (73) 81 \cos(9 - 3x) \quad (74) \frac{1}{27} \sin\left(\frac{x}{3}\right)$$

$$(75) -9 \sec^2(3x) \quad (76) -3 \csc^2(x) \quad (77) [-4 \cos(2x) - 2 \sin(2x)] e^{\cos(2x)-1} \quad (78) 12 \cos(2x) - 12x \sin(2x)$$

$$(79) \frac{-4 \sin(2 \ln(x)) - 2 \cos(2 \ln(x))}{x^2} \quad (80) -12 \sin(3x) - (18x-9) \cos(3x) \quad (81) \frac{-\sin^2(x) - 4 \sin(x) - 2 \cos^2(x)}{(\sin(x) + 4)^3}$$

$$(82) -25 \csc^2(5x) \quad (83) -8 \quad (84) \frac{-1}{8} \cos\left(\frac{x}{2}\right) \quad (85) (x+1)^{2 \cos(x)} \left[\frac{2 \cos(x)}{x+1} - 2 \sin(x) \ln(x+1)\right]$$

$$(86) (4+x)^{\sin(4-x)} \left[\frac{\sin(4-x)}{4+x} - \cos(4-x) \ln(4+x)\right] \quad (87) \frac{(6x+1)^2 \sqrt[4]{2x^2+1}}{e^{1-\cos(x)}} \left[\frac{12}{6x+1} + \frac{x}{2x^2+1} - \sin(x)\right]$$

$$(88) \frac{\sin(4x) e^{3 \sin(x)}}{\sqrt[3]{9x+1}} \left[4 \cot(4x) + 3 \cos(x) - \frac{3}{9x+1}\right] \quad (89) \frac{\sqrt{\sin(3x)+1}}{\cos^2(x) \sqrt[3]{x^2+1}} \left[\frac{3 \cos(x)}{2(\sin(3x)+1)} + 2 \tan(x) - \frac{2x}{3(x^2+1)}\right]$$

$$(90) \frac{(x+2) \sqrt{\cos^3(x)}}{(3x + \cos(2x))^4} \left[\frac{1}{x+2} - \frac{3}{2} \tan(x) - \frac{12 - 8 \sin(2x)}{3x + \cos(2x)}\right]$$

$$(91) \frac{(\sin(3x) - \cos(2x))^4}{2 \sec(x) (\tan(x) + 2)^2} \left[\frac{4(3 \cos(3x) + 2 \sin(2x))}{\sin(3x) - \cos(2x)} - \tan(x) - \frac{2 \sec^2(x)}{\tan(x) + 2}\right] \quad (92) (\sin(3x))^{\frac{1}{x+1}} \left[\frac{3 \cot(3x)}{x+1} - \frac{\ln(\sin(3x))}{(x+1)^2}\right]$$

$$(93) (x^2 + 2)^{\tan(x)} \left[\frac{2x \tan(x)}{x^2 + 2} + \sec^2(x) \ln(x^2 + 2)\right] \quad (94) (\tan(2x) + 3)^{\cos(x)} \left[\frac{2 \sec^2(2x) \cos(x)}{\tan(2x) + 3} - \sin(x) \ln(\tan(2x) + 3)\right]$$

$$(95) (\sin(3x) + \cos(x))^{\sqrt{x+1}} \left[\frac{(3 \cos(3x) - \sin(x)) \sqrt{x+1}}{\sin(3x) + \cos(x)} + \frac{\ln(\sin(3x) + \cos(x))}{2\sqrt{x+1}}\right]$$

$$(96) \left(\ln(\cos(x)) + 4\right)^{\tan(2x)} \left[2 \sec^2(2x) \ln(\ln(\cos(x)) + 4) - \frac{\tan(x) \tan(2x)}{\ln(\cos(x)) + 4}\right]$$

$$(97) \frac{\sqrt[3]{3x+1} e^{\sin(2x)}}{(x^3+1)^3} \left[\frac{1}{3x+1} + 2 \cos(2x) - \frac{9x^2}{x^3+1}\right] \quad (98) \frac{\cos(2x) \sqrt{4x+1}}{e^{\sin(3x)}} \left[-2 \tan(2x) + \frac{2}{4x+1} - 3 \cos(3x)\right]$$

$$(99) (\tan(x))^{2x} \left[\frac{2x \sec^2(x)}{\tan(x)} + 2 \ln(\tan(x))\right]$$