

**GOAL:** Take the derivative of any function, quickly and accurately.

1.  $y = \sin x + \cos x - 3 \cot x + 5 \tan x - \arcsin x$
2.  $y = \csc x - \sec x + x^e - \arctan x$
3.  $y = 4x^3 - x + 5x^\pi - \frac{5}{x} + \frac{3}{\sqrt{x}}$
4.  $y = 1 - x + (3 - 2x)^7 - 2x^8$
5.  $y = \frac{1}{\sqrt[3]{x}} + 1 - 3 \arcsin(x^2)$
6.  $y = x^9 + 9^x + 9^9 + x^x$
7.  $y = \sin x \cos x$
8.  $y = \sin(\cos x)$
9.  $y = \cos(\ln(\tan x))$
10.  $y = \sqrt{\ln x^2} + \arctan \sqrt{x^2 + 1}$
11.  $y = \frac{x + \sin x}{x + \csc x} + \left( \frac{x \arcsin(2x)}{\sin x} \right)^3$
12.  $y = \sqrt[3]{\frac{x^2 - x}{x^3 \arctan(e^x)}}$
13.  $y = \arctan(e^5) + 5^{\tan x} + \tan^5 x + \arctan(e^x)$
14.  $y = \sin^4(x^3) - 5 \ln x \sin^4 x$
15.  $y = e^x \sin x \cos(x^2 - x)$
16.  $y = (1 + x^2)^{50} (1 - x^3)^{71}$
17.  $y = \sqrt{(1 + x^2)^{50} (1 - x^3)^{71}}$
18.  $y = x^2 + x^{\cos x}$
19.  $y = x^{\sqrt{x}}$
20.  $y = (\cos x)^{x^2}$
21.  $y = e^{\csc x} + 3^{x^2} + \arcsin(\cos x)$
22.  $y = \ln(\sqrt{x^3 - 1})$
23.  $y = \log_5(x) + \log_3(x^4) + \log_{10}(\sin x)$
24.  $L = \log_2(ke^k)$ . Find  $dL/dk$ .
25.  $y = \arctan\left(\frac{e^z}{\sin z}\right)$ . Find  $dy/dz$ .
26.  $z = 3cr^5 + b \sin(r^2 - 3\sqrt{r}) - br + c$ . Find  $dz/dr$ , where  $b, c$  are constants.
27.  $h = \frac{T^4 m^3 r}{S^2 F}$ . Find  $dh/dm$ , and then find  $dh/dS$ , and then  $dh/dr$ .

## Answers

1.  $y' = \cos x - \sin x + 3 \csc^2 x + 5 \sec^2 x - \frac{1}{\sqrt{1-x^2}}$
2.  $y' = -\csc x \cot x - \sec x \tan x + ex^{e-1} - \frac{1}{1+x^2}$
3.  $y' = 12x^2 - 1 + 5\pi x^{\pi-1} + \frac{5}{x^2} - \frac{3}{2}x^{-3/2}$
4.  $y' = -1 + 7(3-2x)^6(-2) - 16x^7$
5.  $y' = \frac{-1}{5}x^{-6/5} - \frac{3(2x)}{\sqrt{1-(x^2)^2}}$
6.  $y' = 9x^8 + 9^x \ln 9 + 0 + x^x(\ln x + 1)$
7.  $y' = \cos^2 x - \sin^2 x$
8.  $y' = -\sin x \cos(\cos x)$
9.  $y' = -\sin(\ln(\tan x)) \frac{1}{\tan x} \sec^2 x$
10.  $y' = \frac{1}{2}(\ln x^2)^{-1/2} \frac{1}{x^2} (2x) + \frac{1}{1+(\sqrt{x^2+1})^2} \frac{1}{2} (x^2+1)^{-1/2} (2x)$
11.  $y' = \frac{(x+\csc x)(1+\cos x) - (x+\sin x)(1-\csc x \cot x)}{(x+\csc x)^2} + 3 \left( \frac{x \arcsin(2x)}{\sin x} \right)^2 \left( \frac{\sin x \left( \arcsin(2x) + x \frac{2}{\sqrt{1-(2x)^2}} \right) - x \arcsin(2x) \cos x}{\sin^2 x} \right)$
12.  $y' = \frac{1}{3} \left( \frac{x^2-x}{x^3 \arctan(e^x)} \right)^{-2/3} \left( \frac{[x^3 \arctan(e^x)(2x-1)] - [(x^2-x) \left( 3x^2 \arctan(e^x) + x^3 \frac{e^x}{1+(e^x)^2} \right)]}{[x^3 \arctan(e^x)]^2} \right)$
13.  $y' = 0 + 5^{\tan x} \ln 5 \sec^2 x + 5 \tan^4 x \sec^2 x + \frac{1}{1+(e^x)^2} e^x$
14.  $y' = 4 \sin^3(x^3) \cos(x^3)(3x^2) - 5 \left[ \frac{1}{x} \sin^4 x + 4 \ln x \sin^3 x \cos x \right]$
15.  $y' = e^x \sin x \cos(x^2-x) + e^x \cos x \cos(x^2-x) - e^x \sin x \sin(x^2-x)(2x-1)$
16.  $y' = 50(1+x^2)^{49} (2x)(1-x^3)^{71} + (1+x^2)^{50} 71(1-x^3)^{70} (-3x^2)$
17.  $y' = \frac{1}{2} \left[ (1+x^2)^{50} (1-x^3)^{71} \right]^{-1/2} \left[ 50(1+x^2)^{49} (2x)(1-x^3)^{71} + (1+x^2)^{50} 71(1-x^3)^{70} (-3x^2) \right]$
18.  $y' = 2x + x^{\cos x} (-\sin x \ln x + \frac{1}{x} \cos x)$
19.  $y' = x^{\sqrt{x}} \left( \frac{\ln x}{2\sqrt{x}} + \frac{\sqrt{x}}{x} \right)$
20.  $y' = (\cos x)^{x^2} \left[ 2x \ln(\cos x) + x^2 \frac{1}{\cos x} (-\sin x) \right]$
21.  $y' = -e^{\csc x} \csc x \cot x + 3x^2 (\ln 3)(2x) - \frac{\sin x}{\sqrt{1-(\cos x)^2}}$
22.  $y' = \frac{1}{\sqrt{x^3-1}} \frac{1}{2} (x^3-1)^{-1/2} (3x^2)$
23.  $y' = \frac{1}{x \ln 5} + \frac{4x^3}{x^4 \ln 3} + \frac{\cos x}{\sin x \ln 10}$
24.  $dL/dk = \frac{1}{ke^k \ln 2} (e^k + ke^k)$
25.  $dy/dz = \frac{1}{1+(\frac{e^z}{\sin z})^2} \left( \frac{e^z \sin z - e^z \cos z}{\sin^2 z} \right)$
26.  $dz/dr = 15cr^4 + b \cos(r^2 - 3\sqrt{r}) \left( 2r - \frac{3}{2\sqrt{r}} \right) - b + 0$

27.  $dh/dm = \frac{3T^4 m^2 r}{S^2 F}$ , and  $dh/dS = \frac{-2T^4 m^3 r}{S^3 F}$ , and  $dh/dr = \frac{T^4 m^3}{S^2 F}$