Structural

Linearity

$$\frac{\mathrm{d}}{\mathrm{d}x}\left[f(x) \pm kg(x)\right] = f'(x) \pm kg'(x) \qquad (k \in \mathbb{R})$$

Power rule

$$\frac{\mathrm{d}}{\mathrm{d}x}\, x^n = nx^{n-1} \qquad (n \in \mathbb{R})$$

Product rule

$$\frac{\mathrm{d}}{\mathrm{d}x}\, fg = f'g + fg'$$

Quotient rule

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$$

Chain rule

$$\frac{\mathrm{d}}{\mathrm{d}x}\, f(g(x)) = f'(g(x)) \cdot g'(x)$$

Trig

$$\begin{aligned} \sin x &\xrightarrow{d} \cos x & \csc x &\xrightarrow{d} -\csc x \cot x \\ \cos x &\xrightarrow{d} -\sin x & \sec x &\xrightarrow{d} \sec x \tan x \\ \tan x &\xrightarrow{d} \sec^2 x & \cot x &\xrightarrow{d} -\csc^2 x \end{aligned}$$

Exponential and Logarithm

$$\begin{aligned} e^x &\xrightarrow{d} e^x & \ln x &\xrightarrow{d} \frac{1}{x} \\ b^x &\xrightarrow{d} (\ln b) b^x & \log_b x &\xrightarrow{d} \frac{1}{\ln b} \cdot \frac{1}{x} \end{aligned}$$

where $b > 0$

With chain rule

$$e^{f(x)} \xrightarrow{d} e^{f(x)} \cdot f'(x) \qquad \ln(f(x)) \xrightarrow{d} \frac{1}{f(x)} \cdot f'(x)$$

Inverse Trig

$$\begin{aligned} \sin^{-1} x &\xrightarrow{d} \frac{1}{\sqrt{1-x^2}} & \csc^{-1} x &\xrightarrow{d} \frac{-1}{|x|\sqrt{x^2-1}} \\ \cos^{-1} x &\xrightarrow{d} \frac{-1}{\sqrt{1-x^2}} & \sec^{-1} x &\xrightarrow{d} \frac{1}{|x|\sqrt{x^2-1}} \\ \tan^{-1} x &\xrightarrow{d} \frac{1}{1+x^2} & \cot^{-1} x &\xrightarrow{d} \frac{-1}{1+x^2} \end{aligned}$$

Hyperbolic Trig

$$\sinh x \xrightarrow{d} \cosh x \qquad \operatorname{csch} x \xrightarrow{d} -\operatorname{csch} x \coth x$$
$$\cosh x \xrightarrow{d} \sinh x \qquad \operatorname{sech} x \xrightarrow{d} -\operatorname{sech} x \tanh x$$
$$\tanh x \xrightarrow{d} \operatorname{sech}^2 x \qquad \coth x \xrightarrow{d} -\operatorname{csch}^2 x$$

Inverse Hyperbolic Trig

$$\sinh^{-1} x \xrightarrow{d} \frac{1}{\sqrt{x^2+1}} \qquad \operatorname{csch}^{-1} x \xrightarrow{d} \frac{-1}{|x|\sqrt{1+x^2}} \quad (x \neq 0)$$
$$\cosh^{-1} x \xrightarrow{d} \frac{1}{\sqrt{x^2-1}} \quad (x > 1) \qquad \operatorname{sech}^{-1} x \xrightarrow{d} \frac{-1}{x\sqrt{1-x^2}} \quad (0 < x < 1)$$
$$\tanh^{-1} x \xrightarrow{d} \frac{1}{1-x^2} \quad (|x| < 1) \qquad \coth^{-1} x \xrightarrow{d} \frac{1}{1-x^2} \quad (|x| > 1)$$

(The domain restrictions in the above rules are to make the derivatives match the domain of the corresponding inverse hyperbolic trig function)

- Domain of $\sinh^{-1} x$ is $\mathbb{R}$
- Domain of $\cosh^{-1} x$ is $[1, \infty)$
- Domain of $\tanh^{-1} x$ is $(-1, 1)$.
- Domain of $\operatorname{csch}^{-1} x$ is $x \neq 0$
- Domain of $\operatorname{sech}^{-1} x$ is $(0, 1)$.
- Domain of $\coth^{-1} x$ is $|x| > 1$