Differentiation Formulae and Chain Rule Forms

1. Fixed Powers

$$\frac{d}{dx}(x^n) = nx^{n-1}, \qquad \frac{d}{dx}\left((g(x))^n\right) = n(g(x))^{n-1} \cdot g'(x)$$

2. Exponentials

$$\frac{d}{dx}(e^x) = e^x, \qquad \frac{d}{dx}\left(e^{g(x)}\right) = e^{g(x)} \cdot g'(x)$$

$$\frac{d}{dx}(a^x) = \ln a \cdot a^x, \qquad \frac{d}{dx}\left(a^{g(x)}\right) = \ln a \cdot a^{g(x)} \cdot g'(x)$$

3. Logarithms

$$\frac{d}{dx}(\ln|x|) = \frac{1}{x}, \qquad \frac{d}{dx}(\ln|g(x)|) = \frac{g'(x)}{g(x)}$$

4. Trigonometric Functions

$$\frac{d}{dx}(\sin x) = \cos x, \qquad \frac{d}{dx}(\sin(g(x))) = \cos(g(x)) \cdot g'(x)$$

$$\frac{d}{dx}(\cos x) = -\sin x, \qquad \frac{d}{dx}(\cos(g(x))) = -\sin(g(x)) \cdot g'(x)$$

$$\frac{d}{dx}(\tan x) = \sec^2 x, \qquad \frac{d}{dx}(\tan(g(x))) = \sec^2(g(x)) \cdot g'(x)$$

$$\frac{d}{dx}(\cot x) = -\csc^2 x, \qquad \frac{d}{dx}(\cot(g(x))) = -\csc^2(g(x)) \cdot g'(x)$$

$$\frac{d}{dx}(\sec x) = \sec x \tan x, \qquad \frac{d}{dx}(\sec(g(x))) = \sec(g(x)) \tan(g(x)) \cdot g'(x)$$

$$\frac{d}{dx}(\csc x) = -\csc x \cot x, \qquad \frac{d}{dx}(\csc(g(x))) = -\csc(g(x)) \cot(g(x)) \cdot g'(x)$$

5. Inverse Trigonometric Functions

$$\frac{d}{dx}(\arcsin x) = \frac{1}{\sqrt{1-x^2}}, \qquad \frac{d}{dx}(\arcsin(g(x))) = \frac{g'(x)}{\sqrt{1-(g(x))^2}}$$

$$\frac{d}{dx}(\arccos x) = -\frac{1}{\sqrt{1-x^2}}, \qquad \frac{d}{dx}(\arccos(g(x))) = -\frac{g'(x)}{\sqrt{1-(g(x))^2}}$$

$$\frac{d}{dx}(\arctan x) = \frac{1}{1+x^2}, \qquad \frac{d}{dx}(\arctan(g(x))) = \frac{g'(x)}{1+(g(x))^2}$$

$$\frac{d}{dx}(\operatorname{arccot} x) = -\frac{1}{1+x^2}, \qquad \frac{d}{dx}(\operatorname{arccot}(g(x))) = -\frac{g'(x)}{1+(g(x))^2}$$