

Derivative Reference Sheet

Formal definition of a derivative: $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$

or $f'(x) = \lim_{x_2 - x_1 \rightarrow 0} \frac{f(x_2) - f(x_1)}{x_2 - x_1}$

Function Name	f(x)	f'(x)
Constant function	$f(x) = 5$	$f'(x) = 0$
Power Rule	$f(x) = ax^n$	$f'(x) = anx^{n-1}$
Product Rule	$f(x) = g(x) \cdot h(x)$	$f'(x) = g'(x) \cdot h(x) + g(x) \cdot h'(x)$
Quotient Rule	$f(x) = \frac{g(x)}{h(x)}$	$f'(x) = \frac{h(x) \cdot g'(x) - h'(x) \cdot g(x)}{[h(x)]^2}$
Sine	$f(x) = \sin(g(x))$	$f'(x) = \cos(g(x)) \cdot g'(x)$
Cosine	$f(x) = \cos(g(x))$	$f'(x) = -\sin(g(x)) \cdot g'(x)$
Tangent	$f(x) = \tan(g(x))$	$f'(x) = \sec^2(g(x)) \cdot g'(x)$
Cosecant	$f(x) = \csc(g(x))$	$f'(x) = -\csc(g(x)) \cot(g(x)) \cdot g'(x)$
Secant	$f(x) = \sec(g(x))$	$f'(x) = \sec(g(x)) \tan(g(x)) \cdot g'(x)$
Cotangent	$f(x) = \cot(g(x))$	$f'(x) = -\csc^2(g(x)) \cdot g'(x)$
Chain Rule	$f(x) = g(h(x))$	$f'(x) = g'(h(x)) \cdot h'(x)$
Absolute value	$f(x) = g(x) $	$f'(x) = \frac{g(x) \cdot g'(x)}{ g(x) }$
Natural Log	$f(x) = \ln(g(x))$	$f'(x) = \frac{g'(x)}{g(x)}$
e	$f(x) = e^{g(x)}$	$f'(x) = g'(x) \cdot e^{g(x)}$
Logarithm	$f(x) = \log_a g(x)$	$f'(x) = \frac{g'(x)}{g(x) \cdot \ln a}$
Exponential	$f(x) = a^{g(x)}$	$f'(x) = g'(x) \cdot a^{g(x)} \cdot \ln a$

Function Name	f(x)	f'(x)
Inverses	f(x) and g(x) are inverse functions where $f^{-1}(x)=g(x)$ and $g^{-1}(x)=f(x)$	$f'(x) = \frac{1}{g'(f(x))}$
Inverses – method 2	If (2,3) is on f(x) with slope 4/5 then (3,2) is on $f^{-1}(x)$ with slope 5/4	
Arcsine aka \sin^{-1}	$f(x) = \arcsin(g(x))$	$f'(x) = \frac{g'(x)}{\sqrt{1-g(x)^2}}$
Arccosine aka \cos^{-1}	$f(x) = \arccos(g(x))$	$f'(x) = \frac{-g'(x)}{\sqrt{1-g(x)^2}}$
Arctangent aka \tan^{-1}	$f(x) = \arctan(g(x))$	$f'(x) = \frac{g'(x)}{1+g(x)^2}$
Arccosecant aka \sec^{-1}	$f(x) = \operatorname{arccsc}(g(x))$	$f'(x) = \frac{-g'(x)}{ g(x) \sqrt{g(x)^2-1}}$
Arcsecant aka \sec^{-1}	$f(x) = \operatorname{arcsec}(g(x))$	$f'(x) = \frac{g'(x)}{ g(x) \sqrt{g(x)^2-1}}$
Arccotangent aka \cot^{-1}	$f(x) = \operatorname{arccot}(g(x))$	$f'(x) = \frac{-g'(x)}{1+g(x)^2}$
Hyperbolic Sine aka sinh	$f(x) = \sinh(g(x))$	$f'(x) = \cosh(g(x)) \cdot g'(x)$
Hyperbolic Cosine aka cosh	$f(x) = \cosh(g(x))$	$f'(x) = \sinh(g(x)) \cdot g'(x)$
Hyperbolic Tangent aka tanh	$f(x) = \tanh(g(x))$	$f'(x) = \operatorname{sech}^2(g(x)) \cdot g'(x)$ OR $f'(x) = 1 - \tanh^2(g(x)) \cdot g'(x)$
Hyperbolic Cosecant aka csch	$f(x) = \operatorname{csch}(g(x))$	$f'(x) = -\operatorname{coth}(g(x)) \operatorname{csch}(g(x)) \cdot g'(x)$
Hyperbolic Cosine aka cosh	$f(x) = \cosh(g(x))$	$f'(x) = -\tanh(g(x)) \operatorname{sech}(g(x)) \cdot g'(x)$
Hyperbolic Cotangent aka tanh	$f(x) = \operatorname{coth}(g(x))$	$f'(x) = -\operatorname{csch}^2(g(x)) \cdot g'(x)$ OR $f'(x) = 1 - \operatorname{coth}^2(g(x)) \cdot g'(x)$

Hyperbolic Functions:

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

$$\tanh x = \frac{\sinh x}{\cosh x}$$

Calculator Reference

- Numerical derivative: NDER(2x-1,x,3) means what is the numerical value of the function 2x-1 with respect to x at the value x=3. To find NDER press MATH and 8.
- To graph a derivative: type the function in Y_1 , then type NDER(Y_1,X,X) in Y_2 . To find Y_1 , press VARS, RIGHT ARROW, ENTER, ENTER.
- To graph a tangent line, graph the equation and trace to the point of tangency. Press 2ND, DRAW, 5, ENTER. To remove the line, press 2ND, DRAW, 1.