Derivative Reference Sheet

Formal definition of a derivative: $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ or $f'(x) = \lim_{x_2 - x_1 \to 0} \frac{f(x_2) - f(x_1)}{x_2 - x_1}$

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	$f(x) = \frac{g(x)}{h(x)}$	$f'(x) = \frac{h(x) \bullet g'(x) - h'(x) \bullet g(x)}{[h(x)]^2}$
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	$f(x) = g(h(x))$	$f'(x) = g'(h(x)) \bullet h'(x)$
Absolute value	$f(x) = \|g(x)\|$	$f'(x) = \frac{g(x) \bullet g'(x)}{\|g(x)\|}$
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	$f(x) = \log_a g(x)$	$f'(x) = \frac{g'(x)}{g(x) \bullet \ln a}$
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) = arccsc(g(x))	$f'(x) = \frac{-g'(x)}{\lvert g(x)\rvert\sqrt{g(x)^2-1}}$
Arcsecant aka $\sec^{-1}$	f(x) = arcsec(g(x))	$f'(x) = \frac{g'(x)}{\lvert g(x)\rvert\sqrt{g(x)^2-1}}$
Arccotangent aka $\cot^{-1}$	f(x) = 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))•g'(x)
Hyperbolic Cosine aka cosh	f(x) = cosh(g(x))	f'(x) = sinh(g(x))•g'(x)
Hyperbolic Tangent aka tanh	f(x) = tanh(g(x))	$f'(x) = \text{sech}^2(g(x))\cdot g'(x)$ OR $f'(x) = 1 - \tanh^2(g(x))\cdot g'(x)$
Hyperbolic Cosecant aka csch	f(x) = csch(g(x))	f'(x) = -coth(g(x))csch(g(x))•g'(x)
Hyperbolic Cosine aka cosh	f(x) = cosh(g(x))	f'(x) = -tanh(g(x))sech(g(x))•g'(x)
Hyperbolic Cotangent aka tanh	f(x) = coth(g(x))	$f'(x) = -\text{csch}^2(g(x))\cdot g'(x)$ OR $f'(x) = 1 - \coth^2(g(x))\cdot g'(x)$

Hyperbolic Functions:

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

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 2^{ND}, DRAW, 5, ENTER. To remove the line, press 2^{ND}, DRAW, 1.