Basic Differentiation Formulas

http://www.math.wustl.edu/~freiwald/Math131/derivativetable.pdf

In the table below, $u = f(x)$ and $v = g(x)$ represent differentiable functions of x

Derivative of a constant $\frac{dc}{dx} = 0$

Derivative of constant multiple $\frac{d}{dx}(cu) = c\frac{du}{dx}$ (We could also write $(cf)' = cf'$, and could use the "prime notion" in the other formulas as well)

Derivative of sum or difference $\frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}$

Product Rule $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

Quotient Rule $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

Chain Rule $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$

$\frac{d}{dx}x^n = nx^{n-1}$ $\frac{d}{dx}u^n = nu^{n-1}\frac{du}{dx}$

$\frac{d}{dx}a^x = (\ln a)\,a^x$ $\frac{d}{dx}a^u = (\ln a)\,a^u\frac{du}{dx}$

(If $a = e$) $\frac{d}{dx}e^x = e^x$ $\frac{d}{dx}e^u = e^u\frac{du}{dx}$

$\frac{d}{dx}\log_a x = \frac{1}{(\ln a)\,x}$ $\frac{d}{dx}\log_a u = \frac{1}{(\ln a)\,u}\frac{du}{dx}$

(If $a = e$) $\frac{d}{dx}\ln x = \frac{1}{x}$ $\frac{d}{dx}\ln u = \frac{1}{u}\frac{du}{dx}$

$\frac{d}{dx}\sin x = \cos x$ $\frac{d}{dx}\sin u = \cos u\frac{du}{dx}$

$\frac{d}{dx}\cos x = -\sin x$ $\frac{d}{dx}\cos u = -\sin u\frac{du}{dx}$

$\frac{d}{dx}\tan x = \sec^2 x$ $\frac{d}{dx}\tan u = \sec^2 u\frac{du}{dx}$

$\frac{d}{dx}\cot x = -\csc^2 x$ $\frac{d}{dx}\cot u = -\csc^2 u\frac{du}{dx}$

$\frac{d}{dx}\sec x = \sec x\tan x$ $\frac{d}{dx}\sec u = \sec u\tan u\frac{du}{dx}$

$\frac{d}{dx}\csc x = -\csc x\cot x$ $\frac{d}{dx}\csc u = -\csc u\cot u\frac{du}{dx}$

$\frac{d}{dx}\sin^{-1} x =$ $\frac{d}{dx}\sin^{-1} u =$

$\frac{d}{dx}\arcsin x = \frac{1}{\sqrt{1-x^2}}$ $\frac{d}{dx}\arcsin u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$

$\frac{d}{dx}\tan^{-1} x =$ $\frac{d}{dx}\tan^{-1} u =$

$\frac{d}{dx}\arctan x = \frac{1}{1+x^2}$ $\frac{d}{dx}\arctan u = \frac{1}{1+u^2}\frac{du}{dx}$

Table of Derivatives

Throughout this table, a and b are constants, independent of x.

$F(x)$	$F'(x) = \frac{dF}{dx}$
$af(x) + bg(x)$	$af'(x) + bg'(x)$
$f(x) + g(x)$	$f'(x) + g'(x)$
$f(x) - g(x)$	$f'(x) - g'(x)$
$af(x)$	$af'(x)$
$f(x)g(x)$	$f'(x)g(x) + f(x)g'(x)$
$f(x)g(x)h(x)$	$f'(x)g(x)h(x) + f(x)g'(x)h(x) + f(x)g(x)h'(x)$
$\frac{f(x)}{g(x)}$	$\frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$
$\frac{1}{g(x)}$	$-\frac{g'(x)}{g(x)^2}$
$f\big(g(x)\big)$	$f'\big(g(x)\big)g'(x)$
a	0
x	1
x^a	ax^{a-1}
$g(x)^a$	$ag(x)^{a-1}g'(x)$
$\sin x$	$\cos x$
$\sin g(x)$	$g'(x)\cos g(x)$
$\cos x$	$-\sin x$
$\cos g(x)$	$-g'(x)\sin g(x)$
$\tan x$	$\sec^2 x$
$\csc x$	$-\csc x \cot x$
$\sec x$	$\sec x \tan x$
$\cot x$	$-\csc^2 x$
e^x	e^x
$e^{g(x)}$	$g'(x)e^{g(x)}$
a^x	$(\ln a)\ a^x$
$\ln x$	$\frac{1}{x}$
$\ln g(x)$	$\frac{g'(x)}{g(x)}$
$\log_a x$	$\frac{1}{x \ln a}$
$\arcsin x$	$\frac{1}{\sqrt{1-x^2}}$
$\arcsin g(x)$	$\frac{g'(x)}{\sqrt{1-g(x)^2}}$
$\arccos x$	$-\frac{1}{\sqrt{1-x^2}}$
$\arctan x$	$\frac{1}{1+x^2}$
$\arctan g(x)$	$\frac{g'(x)}{1+g(x)^2}$
$\operatorname{arccsc} x$	$-\frac{1}{x\sqrt{1-x^2}}$
$\operatorname{arcsec} x$	$\frac{1}{x\sqrt{1-x^2}}$
$\operatorname{arccot} x$	$-\frac{1}{1+x^2}$

DIFFERENTIATION TABLE (DERIVATIVES)

Notation: $u = u(x)$ and $v = v(x)$ are differentiable functions of x; c, n, and $a > 0$ are constants; $u' = \dfrac{\mathrm{d}u}{\mathrm{d}x}$ is the derivative of u with respect to (w.r. to) x

(1) $x' = 1$

(2) $c' = 0$

(3) $(cu)' = c \cdot u'$

(4) $(u \pm v)' = u' \pm v'$

(5) $(uv)' = u'v + v'u$

(6) $\left(\dfrac{u}{v}\right)' = \dfrac{u'v - v'u}{v^2}$

(7) $(u^n)' = nu^{n-1}u'$

(a) $\left(\dfrac{1}{u}\right)' = -\dfrac{u'}{u^2}$

(b) $(\sqrt{u}\,)' = \dfrac{u'}{2\sqrt{u}}$

(8) $(\sin u)' = \cos u \; u'$

(9) $(\cos u)' = -\sin u \; u'$

(10) $(\tan u)' = \sec^2 u \; u'$

(11) $(\cot u)' = -\csc^2 u \; u'$

(12) $(\sec u)' = \sec u \; \tan u \; u'$

(13) $(\csc u)' = -\csc u \; \cot u \; u'$

(14) $(a^u)' = a^u(\ln a)u'$

(15) $(e^u)' = e^u u'$

(16) $(\ln u)' = \dfrac{u'}{u}$

(17) $(\sin^{-1} u)' = \dfrac{u'}{\sqrt{1 - u^2}}$

(18) $(\cos^{-1} u)' = -\dfrac{u'}{\sqrt{1 - u^2}}$

(19) $(\tan^{-1} u)' = \dfrac{u'}{1 + u^2}$

(Note: $\sin^{-1}$ = arcsin, $\cos^{-1}$ = arccos, $\tan^{-1}$ = arctan.)