Notation

Name	Operation	y versions	f(x) versions	Composition versions	Second derivative	Nth derivative
Leibniz Notation	d/dx (f(x))=d/dx (y)	**dy/dx=dy(-x)/dx**	df/dx=df(x)/dx=d(f-(x))/dx	**df/dg*dg/dx**	**d^2f/dx^2**	**d^nf/dx^n**
Lagrange Notation	d/dx (f(x))=d/dx (y)	**y'**	**f'=f'(x)**=(f(x))'	(f(g(x)))'	**y''**	**$f^n(x)$**
Newton/Dot Notation	d/dt (f(t))=d/dt (y(t))	ẏ			ÿ	
Euler/D-Notation	$D_x(f)$	Dy	Df	D(f(g))	D^2f	D^nf

Derivative Rules

Formal/Limit Definition of a Derivative	lim h->0 of f(x+h)-f(x)/h	lim x->a of (f(x)-f(a))/(x-a)	
Linearity 1: Constant-Multiple Rule	**d/dx (kf)**	**k*d/dx (f)**	**kf'**
Linearity 2: Sum-Difference Rule	**d/dx (f±g)**	**d/dx (f) ± d/dx (g)**	**f'±g'**
Product Rule	**d/dx (fg)**	**f'g+fg'**	
Multi-Product Rule	d/dx (pqrs...)	p'qrs... + pq'rs... + pqr's... + pqrs'... + ...	pqrs...*(p'/p + q'/q + r'/r + s'/s + ...)
Quotient Rule	d/dx (f/g)	$(f'g-fg')/g^2$	g≠0, quotients can be rewritten into products with sign-flipped exponents
Chain Rule	**d/dx (f(g))**	**f'(g)g'**	
Multi-Chain Rule	**d/dx (p(q(r-(s(...)))))**	**p'(q(r(s(...))))*q'(r(s(...)))*r'(s(...))*s'(...)*...**	
Fundamental Theorem of Calculus I (FTC I)	**d/dx ($\int_a^x f(t)dt$)**	**f(x)**	**Derivatives and integrals are inverses of each other**
FTC I Chain Rule 1	d/dx ($\int_a^v f(t)dt$)	f(v)v'	
FTC I Chain Rule 2	d/dx ($\int_u^v f(t)dt$)	f(v)v'-f(u)u'	

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Derivative Rules (cont)

Summation Rule	d/dx (Σf(x))	Σf'(x)	The summation must be within its interval of convergence

Let a and k be constants/scalars
Let f, g, p, q, r, s, u, and v be functions of x, that is, f=f(x), g=g(x), p=p(x) and q=q(x), r=r(x), s=s(x), u=u(x), and v=v(x), unless otherwise shown

Derivatives of Algebraic Functions

Rule	Function	Derivative	Function Composition	Chain Rule
Constant	**d/dx (k)**	**0**	**d/dx (f(k))**	**0**
Power	**d/dx (x^n)**	**nx^{n-1}**	**d/dx (u^n)**	**$nu^{n-1}u'$**
Natural Exponential	**d/dx (e^x)**	**e^x**	**d/dx (e^u)**	**$e^u u'$**
Natural Logarithm	**d/dx (ln(x))**	**1/x**	**d/dx (ln(u))**	**u'/u**
General Exponential	d/dx (a^x)	$a^x \ln(a)$	d/dx (a^u)	$a^u \ln(a) u'$
General Logarithm	d/dx ($\log_a(x)$)	1/(xln(a))	d/dx ($\log_a(u)$)	u'/(uln(a))
Absolute Value	d/dx (|x|)	x/|x|	d/dx (|u|)	u'*u/|u|
Function-Power-Function	d/dx ($f(x)^{g(x)}$)	$f^g(f'g/f+\ln(f)g')$		

Derivatives of Trigonometric Functions

Standard Trigonometric	Derivative	Inverse Trigonometric	Derivative	Hyperbolic Trigonometric	Derivative	Hyperbolic Inverse Trigonometric	Derivative
d/dx (sin(x))	**cos(x)**	**d/dx (arcsin(x))**	**$1/\sqrt{(1-x^2)}$**	d/dx (sinh(x))	cosh(x)	d/dx (arcsinh(x))	$1/\sqrt{(1+x^2)}$
d/dx (cos(x))	**-sin(x)**	d/dx (arccos(x))	$-1/\sqrt{(1-x^2)}$	d/dx (cosh(x))	sinh(x)	d/dx (arccosh(x))	$-1/\sqrt{(x^2-1)}$
d/dx (tan(x))	**$\sec^2(x)$**	**d/dx (arctan(x))**	**$1/(1+x^2)$**	d/dx (tanh(x))	$\operatorname{sech}^2(x)$	d/dx (arctanh(x))	$1/(1-x^2)$
d/dx (csc(x))	-csc(x)cot(x)	d/dx (arccsc(x))	$-1/(\lvert x\rvert \sqrt{(x^2-1)})$	d/dx (csch(x))	-csch(x)coth(x)	d/dx (arccsch(x))	$-1/(\lvert x\rvert \sqrt{(x^2+1)})$
d/dx (sec(x))	**sec(x)-tan(x)**	d/dx (arcsec(x))	$1/(\lvert x\rvert\sqrt{(x^2-1)})$	d/dx (sech(x))	-sech(x)tanh(x)	d/dx (arcsech(x))	$-1/(\lvert x\rvert\sqrt{(1-x^2)})$
d/dx (cot(x))	$-\csc^2(x)$	d/dx (arccot(x))	$-1/(1+x^2)$	d/dx (coth(x))	$-\operatorname{csch}^2(x)$	d/dx (arccoth(x))	$1/(1-x^2)$

$\sinh(x)=(e^x-e^{-x})/2$
$\cosh(x)=(e^x+e^{-x})/2$
$\operatorname{arcsinh}(x)=\ln(x+\sqrt{(x^2+1)})$
$\operatorname{arccosh}(x)=\ln(x+\sqrt{(x^2-1)}),\ x\geq 1$

Polynomials	
d/dx (x)	**1**
d/dx (x^2)	**2x**
d/dx (x^3)	**$3x^2$**
d/dx (x^4)	$4x^3$
d/dx (1/x)	**$-1/x^2$**
d/dx ($-1/x^2$)	**$2/x^3$**
d/dx ($2/x^3$)	$-6/x^4$
d/dx ($-6/x^4$)	$24/x^5$
d/dx (√x)	**$1/(2\sqrt{x})$**
d/dx ($x^{1/3}$)	**$1/(3x^{2/3})$**
d/dx ($x^{1/4}$)	$1/(4x^{3/4})$
d/dx ($x^{3/2}$)	$3/(2\sqrt{x})$
d/dx ($x^{5/3}$)	$5/(3x^{2/3})$
d/dx (1/(1+x))	$-1/(1+x)^2$
d/dx ($-1/(1+x)^2$)	$2/(1+x)^3$
d/dx (-1/(1-x))	$-1/(1-x)^2$
d/dx ($-1/(1-x)^2$)	$-2/(1-x)^3$
d/dx (√(5x+1))	$5/(2\sqrt{(4x+1)})$
d/dx (√(x^5+1))	$5x^4/(2\sqrt{(x^5+1)})$
d/dx (($2x^2$+5)^9)	$36x(2x^2+5)^8$
d/dx (1)	**0**

Special/Other	
d/dx (e^xsin(x))	e^xsin(x)+e^xcos(x)
d/dx (e^xcos(x))	e^xcos(x)-e^xsin(x)
d/dx ($\sin^x$(x))	$\sin^x$(x)(ln(sin(x))+xcot(x))
d/dx (ln(x^3+7x+12))	**$(3x^2+7)/(x^3+7x+12)$**
d/dx (ln(e^{3x}tan(x^3)))	$3+(3x^2\sec^2(x^3))/(\tan(x^3))$
d/dx (1+k+t+√2+cos(a)+e+π+ln(3))	**0**

Trigonometric	
d/dx (-sin(x))	**-cos(x)**
d/dx (-cos(x))	**sin(x)**
d/dx (sin(2x))	**2cos(2x)**
d/dx (cos(2x))	**-2sin(2x)**
d/dx ($\sin^2$(x))	2sin(x)cos(x)
d/dx ($\cos^2$(x))	-2cos(x)sin(x)
d/dx (arctan(3x))	**$3/(1+9x^2)$**
d/dx (sin(sin(x)))	cos(x)cos(sin(x))
d/dx (sin(arccos(x)))	$-x/\sqrt{(1-x^2)}$
d/dx (sin(k))	**0**

Exponential	
d/dx (xe^x)	e^x+xe^x
d/dx (e^{2x})	**$2e^{2x}$**
d/dx (e^{x^2})	**$2xe^{x^2}$**
d/dx (e^{e^x})	$e^x e^{e^x}$
d/dx (x^x)	x^x(ln(x)+1)
d/dx (2^{3^x})	$2^{3^x}*3^x*\ln(2)*\ln(3)$
d/dx (e^k)	**0**

Logarithmic	
d/dx (ln(1/x))	-1/x
d/dx (ln(1+x))	1/(1+x)
d/dx (ln(1-x))	-1/(1-x)
d/dx (ln(x^2))	**2/x**
d/dx (ln(x^3))	3/x
d/dx (ln(x^4))	4/x
d/dx (xln(x))	ln(x)+1
d/dx (ln(ln(x)))	1/(xln(x))
d/dx (ln(k))	**0**