$F(x)$ is **antiderivative** of $f(x)$ if $F'(x) = f(x)$	indefinite integral $\int f(x)dx = F(x)+c$	definite integral $\int_a^b f(x)dx = F(b)-F(a)$	u - substitution $\int f[u(x)]u'(x)dx = \int f(u)du$	integration by parts $\int u\,dv = uv - \int v\,du$	$\frac{d}{dx}\int_a^x f(t)dt = f(x)$

$f(x)$	$F(x)$
x^n	$\frac{x^{n+1}}{n+1}$ $\quad n \neq -1$
$\frac{1}{x}$	$\ln\lvert x\rvert$
e^x	e^x
e^{ax}	$\frac{e^{ax}}{a}$
a^x	$\frac{a^x}{\ln a}$
xe^{ax}	$\frac{e^{ax}}{a^2}(ax-1)$
$x^n e^{ax}$	$\frac{x^n e^{ax}}{a} - \frac{n}{a}\int x^{n-1}e^{ax}dx$ $\quad n \geq 1$
$\frac{e^{ax}}{x}$	$\ln x + ax + \frac{(ax)^2}{2\cdot 2!} + \frac{(ax)^3}{3\cdot 3!} + \cdots$
$\ln x$	$x\ln x - x$
$x\ln x$	$\frac{x^2}{2}\ln x - \frac{x^2}{4}$
$x^n \ln x$	$x^{n+1}\left(\frac{\ln x}{n+1} - \frac{1}{(n+1)^2}\right)$ $\quad n \neq -1$
$\frac{(\ln x)^n}{x}$	$\frac{(\ln x)^{n+1}}{n+1}$ $\quad n \neq -1$
$\frac{1}{x\ln x}$	$\ln\lvert\ln x\rvert$
$(\ln x)^2$	$x(\ln x)^2 - 2\ln x + 2x$
$\frac{1}{x^2+a^2}$	$\frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$
$\frac{1}{x^2-a^2}$	$\frac{1}{2a}\ln\left\lvert\frac{x-a}{x+a}\right\rvert$
$\frac{1}{\sqrt{a^2-x^2}}$	$\sin^{-1}\left(\frac{x}{a}\right)$
$\frac{1}{\sqrt{x^2 \pm a^2}}$	$\ln\left(x + \sqrt{x^2 \pm a^2}\right)$
$\sqrt{a^2-x^2}$	$\frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)$
$\sqrt{x^2-a^2}$	$\frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\ln\left\lvert x+\sqrt{x^2-a^2}\right\rvert$
$\sqrt{x^2+a^2}$	$\frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2}\ln\left\lvert x+\sqrt{x^2+a^2}\right\rvert$

$f(x)$	$F(x)$
$\sin x$	$-\cos x$
$\cos x$	$\sin x$
$\tan x$	$-\ln\lvert\cos x\rvert$
$\cot x$	$\ln\lvert\sin x\rvert$
$\sec x$	$\ln\lvert\sec x + \tan x\rvert$
$\csc x$	$\ln\lvert\csc x - \cot x\rvert$
$\sin^2 x$	$\frac{x}{2} - \frac{\sin x\cos x}{2}$
$\cos^2 x$	$\frac{x}{2} + \frac{\sin x\cos x}{2}$
$\tan^2 x$	$\tan x - x$
$\cot^2 x$	$-\cot x - x$
$\sec^2 x$	$\tan x$
$\csc^2 x$	$-\cot x$
$\sin^n x$	$-\frac{\sin^{n-1}x\cos x}{n} + \frac{n-1}{n}\int\sin^{n-2}x\,dx$
$\cos^n x$	$\frac{\cos^{n-1}x\sin x}{n} + \frac{n-1}{n}\int\cos^{n-2}x\,dx$
$\tan^n x$	$\frac{\tan^{n-1}x}{n-1} - \int\tan^{n-2}x\,dx$
$\cot^n x$	$-\frac{\cot^{n-1}x}{n-1} - \int\cot^{n-2}x\,dx$
$\sec^n x$	$\frac{\sec^{n-1}x\sin x}{n-1} + \frac{n-2}{n-1}\int\sec^{n-2}x\,dx$
$\csc^n x$	$-\frac{\csc^{n-1}x\cos x}{n-1} + \frac{n-2}{n-1}\int\csc^{n-2}x\,dx$
$\sinh(ax)$	$\frac{\cosh(ax)}{a}$
$\cosh(ax)$	$\frac{\sinh(ax)}{a}$
$\tanh(ax)$	$\frac{\ln[\cosh(ax)]}{a}$
$\coth(ax)$	$\frac{\ln[\sinh(ax)]}{a}$

quadratic equation

$$ax^2 + bx + c = 0 \qquad x_{1,2} = \frac{-b \pm \sqrt{a^2 - bc}}{2a}$$

binomial formula

$$(x \pm y)^n = \sum_{k=0}^{n}\binom{h}{k}(\pm 1)^k x^{n-k}y^k \qquad \binom{h}{k} = \frac{n!}{(n-k)!k!}$$

$$a^x = e^{x\ln a} \qquad \log_a x = \frac{\ln x}{\ln a}$$

hyperbolic functions

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

$$e^{a+ib} = e^a(\cos b + i\sin b)$$ Euler's formula

$$\sin 2x = 2\sin x\cos x$$

$$\cos 2x = \cos^2 x - \sin^2 x = 1 - 2\sin^2 x = 2\cos^2 x - 1$$

$$\sin^2 x = \frac{1-\cos 2x}{2} \qquad \cos^2 x = \frac{1+\cos 2x}{2}$$

$$\tan^2 x = \sec^2 x - 1 \qquad \tan^2 x + 1 = \sec^2 x$$

$$\cot^2 x = \csc^2 x - 1 \qquad \cot^2 x + 1 = \csc^2 x$$

$$\sin(x \pm y) = \sin x\cos y \pm \cos x\sin y$$

$$\cos(x \pm y) = \cos x\cos y \mp \sin x\sin y$$

$$\sin x\cos y = \frac{1}{2}\sin(x-y) + \frac{1}{2}\sin(x+y)$$

$$\sin x\sin y = \frac{1}{2}\cos(x-y) - \frac{1}{2}\cos(x+y)$$

$$\cos x\cos y = \frac{1}{2}\cos(x-y) + \frac{1}{2}\cos(x+y)$$

$$\sin x \pm \sin y = 2\sin\frac{x \pm y}{2}\cos\frac{x \mp y}{2}$$

$$\cos x + \cos y = 2\cos\frac{x+y}{2}\cos\frac{x-y}{2}$$

$$\cos x - \cos y = -2\sin\frac{x+y}{2}\sin\frac{x-y}{2}$$

$$a\cos\alpha + b\sin\alpha = \sqrt{a^2+b^2}\sin(\alpha+\beta) \qquad \beta = \tan^{-1}\frac{a}{b}$$

Liebniz' rule

$$\frac{d}{dt}\left(\int_{a(t)}^{b(t)}\phi(x,t)dx\right) = \int_{a(t)}^{b(t)}\frac{\partial\phi(x,t)}{\partial t}dx + \phi[b(t),t]\frac{db(t)}{dt} - \phi[a(t),t]\frac{da(t)}{dt}$$