환 원 관 계

각	sine	cosine	tangent	cotangent	secant	cosecant
$-x$	$-\sin x$	$\cot x$	$-\tan x$	$-\cot x$	$\sec x$	$-\mathrm{cosec}\, x$
$90-x$	$\cos x$	$\sin x$	$\cot x$	$\tan x$	$\mathrm{cosec}\, x$	$\sec x$
$90+x$	$\cos x$	$-\sin x$	$-\cot x$	$-\tan x$	$-\mathrm{cosec}\, x$	$\sec x$
$180-x$	$\sin x$	$-\cos x$	$-\tan x$	$-\cot x$	$-\sec x$	$\mathrm{cosec}\, x$
$180+x$	$-\sin x$	$-\cos x$	$\tan x$	$\cot x$	$-\sec x$	$-\mathrm{cosec}\, x$
$270-x$	$-\cos x$	$-\sin x$	$\cot x$	$\tan x$	$-\mathrm{cosec}\, x$	$-\sec x$
$270+x$	$-\cos x$	$\sin x$	$-\cot x$	$-\tan x$	$\mathrm{cosec}\, x$	$-\sec x$
$360-x$	$-\sin x$	$\cos x$	$-\tan x$	$-\cot x$	$\sec x$	$-\mathrm{cosec}\, x$

Taylor 급수

- $e^x = 1+\frac{x}{1!}+\frac{x^2}{2!}+\frac{x^3}{3!}+\cdots \quad -\infty < x < \infty$
- $a^x = e^{x\ln a} = 1+x\ln a+\frac{(x\ln a)^2}{2!}+\frac{(x\ln a)^3}{3!}+\cdots \quad -\infty < x < \infty$
- $\ln(1+x) = x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\cdots \quad -1 < x \le 1$
- $\frac{1}{2}\ln\left(\frac{1+x}{1-x}\right) = x+\frac{x^3}{3}+\frac{x^5}{5}+\frac{x^7}{7}+\cdots \quad -1 < x < 1$
- $\ln x = 2\left\{\left(\frac{x-1}{x+1}\right)+\frac{1}{3}\left(\frac{x-1}{x+1}\right)^3+\frac{1}{5}\left(\frac{x-1}{x+1}\right)^5+\cdots\right\} \quad x>0$
- $\ln x = \left(\frac{x-1}{x}\right)+\frac{1}{2}\left(\frac{x-1}{x}\right)^2+\frac{1}{3}\left(\frac{x-1}{x}\right)^3+\cdots \quad x \ge \frac{1}{2}$
- $\sin x = x-\frac{x^3}{3!}+\frac{x^5}{5!}-\frac{x^7}{7!}+\cdots \quad -\infty < x < \infty$
- $\cos x = 1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^6}{6!}+\cdots \quad -\infty < x < \infty$
- $\tan x = x+\frac{x^3}{3}+\frac{2x^5}{15}+\frac{17x^7}{315}+\cdots+\frac{2^{2n}(2^{2n}-1)B_n x^{2n-1}}{(2n)!}+\cdots \quad |x| < \frac{\pi}{2}$
- $\cot x = \frac{1}{x}-\frac{x}{3}-\frac{x^3}{45}-\frac{2x^5}{945}-\cdots-\frac{2^{2n}B_n x^{2n-1}}{(2n)!}-\cdots \quad 0 < |x| < \pi$
- $\sec x = 1+\frac{x^2}{2}+\frac{5x^4}{24}+\frac{61x^6}{720}+\cdots+\frac{E_n x^{2n}}{(2n)!}+\cdots \quad |x| < \frac{\pi}{2}$
- $\csc x = \frac{1}{x}+\frac{x}{6}+\frac{7x^3}{360}+\frac{31x^5}{15,120}+\cdots+\frac{2(2^{2n-1}-1)B_n x^{2n-1}}{(2n)!}+\cdots \quad 0 < |x| < \pi$
- $\sin^{-1}x = x+\frac{1}{2}\frac{x^3}{3}+\frac{1\cdot 3}{2\cdot 4}\frac{x^5}{5}+\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{x^7}{7!}+\cdots \quad |x| < 1$
- $\cos^{-1}x = \frac{\pi}{2}-\sin^{-1}x = \frac{\pi}{2}-\left(x+\frac{1}{2}\frac{x^3}{3}+\frac{1\cdot 3}{2\cdot 4}\frac{x^5}{5}+\cdots\right) \quad |x| < 1$

Taylor 급수

▶ $\tan^{-1}x = \begin{cases} x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots & |x| < 1 \\ \pm\frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \cdots & [+ \text{ if } x \geq 1,\ \text{if } x \leq -1] \end{cases}$

▶ $\cot^{-1}x = \frac{\pi}{2} - \tan^{-1}x$

$= \begin{cases} \frac{\pi}{2} - \left(x - \frac{x^3}{3} + \frac{x^5}{5} - \cdots\right) & |x| < 1 \\ p\pi + \frac{1}{x} - \frac{1}{3x^3} + \frac{1}{5x^5} - \cdots & [p = 0 \text{ if } x > 1,\ p = 1 \text{ if } x < -1] \end{cases}$

▶ $\sec^{-1}x = \cos^{-1}(1/x) = \frac{\pi}{2} - \left(\frac{1}{x} + \frac{1}{2 \cdot 3x^3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5x^5} + \cdots\right) \quad |x| > 1$

▶ $\csc^{-1}x = \sin^{-1}(1/x) = \frac{1}{x} + \frac{1}{2 \cdot 3x^3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5x^5} + \cdots \quad |x| > 1$

▶ $\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \cdots \quad -\infty < x < \infty$

▶ $\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \cdots \quad -\infty < x < \infty$

▶ $\tanh x = x - \frac{x^3}{3} + \frac{2x^5}{15} - \frac{17x^7}{315} + \cdots \frac{(-1)^{n-1}2^{2n}(2^{2n}-1)B_n x^{2n-1}}{(2n)!} + \cdots \quad |x| < \frac{\pi}{2}$

▶ $\coth x = \frac{1}{x} + \frac{x}{3} - \frac{x^3}{45} + \frac{2x^5}{945} - \cdots \frac{(-1)^{n-1}2^{2n}B_n x^{2n-1}}{(2n)!} - \cdots \quad 0 < |x| < \pi$

▶ $\text{sec h } x = 1 - \frac{x^2}{2} + \frac{5x^4}{24} - \frac{61x^6}{720} + \cdots \frac{(-1)^n E_n x^{2n}}{(2n)!} + \cdots \quad |x| < \frac{\pi}{2}$

▶ $\text{csc h } x = \frac{1}{x} - \frac{x}{6} + \frac{7x^3}{360} - \frac{31x^5}{15,120} + \cdots \frac{(-1)^n 2(2^{2n-1}-1)B_n x^{2n-1}}{(2n)!} + \cdots \quad 0 < |x| < \pi$

▶ $\sinh^{-1}x$

$= \begin{cases} x - \frac{x^3}{2 \cdot 3} + \frac{1 \cdot 3x^5}{2 \cdot 4 \cdot 5} - \frac{1 \cdot 3 \cdot 5x^7}{2 \cdot 4 \cdot 6 \cdot 7} + \cdots & |x| < 1 \\ \pm\left(\ln|2x| + \frac{1}{2 \cdot 2x^2} - \frac{1 \cdot 3}{2 \cdot 4 \cdot 4x^4} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 6x^6} - \cdots\right) & \begin{bmatrix} + \text{ if } x \geq 1 \\ - \text{ if } x \leq -1 \end{bmatrix} \end{cases}$

▶ $\cosh^{-1}x = \pm\left\{\ln(2x) - \left(\frac{1}{2 \cdot 2x^2} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 4x^4} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 6x^6} + \cdots\right)\right\}$

$\begin{bmatrix} + \text{ if } \cosh^{-1}x > 0,\ x \geq 1 \\ - \text{ if } \cosh^{-1}x < 0,\ x \geq 1 \end{bmatrix}$

▶ $\tanh^{-1}x = x + \frac{x^3}{3} + \frac{x^5}{5} + \frac{x^7}{7} + \cdots \quad |x| < 1$

▶ $\coth^{-1}x = \frac{1}{x} + \frac{1}{3x^3} + \frac{1}{5x^5} + \frac{1}{7x^7} + \cdots \quad |x| > 1$

Taylor 급수

- $e^{\sin x} = 1 + x + \frac{x^2}{2} - \frac{x^4}{8} - \frac{x^5}{15} + \cdots \quad -\infty < x < \infty$
- $e^{\cos x} = e\left(1 - \frac{x^2}{2} + \frac{x^4}{6} - \frac{31x^6}{720} + \cdots\right) \quad -\infty < x < \infty$
- $e^{\tan x} = 1 + x + \frac{x^2}{2} + \frac{x^3}{2} + \frac{3x^4}{8} + \cdots \quad |x| < \frac{\pi}{2}$
- $e^x \sin x = x + x^2 + \frac{x^3}{3} - \frac{x^5}{30} - \frac{x^6}{90} + \cdots + \frac{2^{n/2}\sin(n\pi/4)\,x^n}{n!} + \cdots$
  $-\infty < x < \infty$
- $e^x \cos x = 1 + x - \frac{x^3}{3} - \frac{x^4}{6} + \cdots + \frac{2^{n/2}\cos(n\pi/4)\,x^n}{n!} + \cdots \quad -\infty < x < \infty$
- $\ln|\sin x| = \ln|x| - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \cdots - \frac{2^{2n-1}B_n x^{2n}}{n(2n)!} + \cdots$
  $-0 < |x| < \pi$
- $\ln|\cos x| = -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \cdots - \frac{2^{2n-1}(2^{2n}-1)B_n x^{2n}}{n(2n)!} + \cdots$
  $|x| < \frac{\pi}{2}$
- $\ln|\tan x| = \ln|x| + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \cdots + \frac{2^{2n}(2^{2n-1}-1)B_n x^{2n}}{n(2n)!} + \cdots$
  $0 < |x| < \frac{\pi}{2}$
- $\frac{\ln(1+x)}{1+x} = x - \left(1 + \frac{1}{2}\right)x^2 + \left(1 + \frac{1}{2} + \frac{1}{3}\right)x^3 - \cdots \quad |x| < 1$

수에 관한 접두어

수	이름	기호	수	이름	기호
10^{12}	tera	T	10^{-1}	deci	d
10^{9}	giga	G	10^{-2}	centi	c
10^{6}	mega	M	10^{-3}	milli	m
10^{5}	hectokilo	hk	10^{-4}	decimilli	dm
10^{4}	myria	ma	10^{-5}	centimilli	cm
10^{3}	kilo	k	10^{-6}	micro	μ
10^{2}	hecto	h	10^{-9}	nano	n
10	deca	da	10^{-12}	pico	p

Constant

Avogadro's number	$N_A = 6.02\times10^{23}$ molecules/mole
Boltzmann's constant	$k = 1.38\times10^{-23}$ J/K $= 8.62\times10^{-5}$ eV/K
Electro rest mass	$m_0 = 9.11\times10^{-31} kg$
Plank's constant	$h = 6.63\times10^{-34}$ J-s $= 4.14\times10^{-15}$ eV-s
$q = 1.60\times10^{-19}$ C	$\varepsilon_0 = 8.85\times10^{-14}$ F/cm $= 8.85\times10^{-12}$ F/m
$kT = 0.0259$ eV	c $= 2.998\times10^{10}$ cm/s
1 Å (angstrom) $= 10^{-8}$ cm	1eV $= 1.6\times10^{-19}$ J
1μm (micron) $= 10^{-4}$ cm	1nm $= 10$ Å $= 10^{-7}$ cm