Greek characters

Name	Symbol	Typical use(s)
alpha	α	angle, constant
beta	β	angle, constant
gamma	γ	angle, constant
delta	δ	limit definition
epsilon	ϵ or ε	limit definition
theta	θ or ϑ	angle
pi	π or ϖ	circular constant
phi	ϕ or φ	angle, constant

Named sets

empty set	$\varnothing$
real numbers	$\mathbf{R}$
ordered pairs	$\mathbf{R}^2$

integers	$\mathbf{Z}$
positive integers	$\mathbf{Z}_{>0}$
positive reals	$\mathbf{R}_{>0}$

Set symbols

Meaning	Symbol
is a member	$\in$
subset	$\subset$
intersection	$\cap$

Meaning	Symbol
union	$\cup$
complement	superscript^C
set minus	$\setminus$

Logic symbols

Meaning	Symbol
negation	$\neg$
and	$\wedge$
or	$\vee$
implies	$\implies$

Meaning	Symbol
equivalent	$\equiv$
iff	$\iff$
for all	$\forall$
there exists	$\exists$

Arithmetic properties

$(\forall a, b \in \mathbf{R})(a + b = b + a)$ commutivity

$(\forall a, b, c \in \mathbf{R})(a + (b + c) = (a + b) + c)$ commutivity

$(\forall a, b \in \mathbf{R})(ab = ba)$ commutivity

$(\forall a, b, c \in \mathbf{R})(a(bc) = (ab)c)$ commutivity

$(\forall a, b, c \in \mathbf{R})(a(b + c) = ab + ac)$ distributive

Distance & Midpoint

The distance between the points (x_1, y_1) and (x_2, y_2) is

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}.$$

The midpoint is the point

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$

Exponents

For $a, b > 0$ and m, n real:

$$a^0 = 1, \qquad 0^a = 0$$
$$1^a = 1, \qquad a^n a^m = a^{n+m}$$
$$a^n/a^m = a^{n-m}, \qquad (a^n)^m = a^{n \cdot m}$$
$$a^{-m} = 1/a^m, \qquad (a/b)^m = a^m/b^m$$

Solution of Equations

Algebraic

$$[ab = 0] \equiv [a = 0 \textbf{ or } b = 0]$$
$$[a^2 = b^2] \equiv [a = b \textbf{ or } a = -b]$$
$$\left[\frac{a}{b} = 0\right] \equiv [a = 0 \textbf{ and } b \neq 0]$$
$$\left[\frac{a}{b} = \frac{c}{d}\right] \equiv [ad = bc \textbf{ and } b \neq 0 \textbf{ and } d \neq 0]$$
$$[|a| = |b|] \equiv [a = b \textbf{ or } a = -b]$$
$$[\sqrt{a} = b] \equiv [a = b^2 \textbf{ and } b \geq 0]$$

For $a \neq 0$,

$$[ax^2 + bx + c = 0] \equiv \left[x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right]$$

Exponential

$$[\ln(a) = 0] \equiv [a = 1]$$
$$[\text{euler}^a = 1] \equiv [a = 0]$$
$$[\ln(a) = b] \equiv [a = \text{euler}^b]$$
$$[\ln(a) = b] \equiv [a = \text{euler}^b]$$

Parabolas & Lines

The vertex of the parabola $ax^2 + bx + c = y$ is

$$\left(x = -\frac{b}{2a}, y = c - \frac{b^2}{4a}\right).$$

An equation of the line that contains the points $(x = x_1, y = y_1), (x = x_2, y = y_2)$ is

$$y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1).$$

The number $\frac{y_2 - y_1}{x_2 - x_1}$ is the slope.

Radicals

$$\sqrt[n]{a} = a^{1/n}$$
$$\sqrt[n]{ab} = \sqrt[n]{a}\sqrt[n]{b} \quad (\text{provided } a, b \geq 0)$$
$$\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$$
$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$
$$\sqrt[n]{a^n} = \begin{cases} a & n \text{ odd} \\ |a| & n \text{ even} \end{cases}$$

Identities

$$a(b + c) = ab + ac$$
$$((a + b))(c + d) = ac + ad + bc + bd$$
$$\frac{ab + ac}{a} = b + c \quad (\text{provided } a \neq 0)$$
$$\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{ad}{bc} \quad (\text{provided } b, d \neq 0)$$
$$\sqrt{ab} = \sqrt{a}\sqrt{b} \quad (\text{provided } a \geq 0, b \geq 0)$$
$$\ln(ab) = \ln(a) + \ln(b) \quad (\text{provided } a \geq 0, b \geq 0)$$

Function notation

$\text{dom}(F)$	domain of function F
$\text{range}(F)$	range of function F

Domains, Ranges, and Zeros

Function	Domain	Range	Zeros
$\ln, \log$	$(0, \infty)$	$(-\infty, \infty)$	1
exp	$(-\infty, \infty)$	$(0, \infty)$	$\varnothing$
abs	$(-\infty, \infty)$	$(0, \infty)$	0
$\sqrt{\ }$	$(0, \infty)$	$(0, \infty)$	0
$\sqrt[3]{\ }$	$(-\infty, \infty)$	$(-\infty, \infty)$	0
floor	$(-5, 5)$	$\mathbf{Z}$	$[0, 1)$
ceiling	$(-\infty, \infty)$	$\mathbf{Z}$	$(-1, 0]$

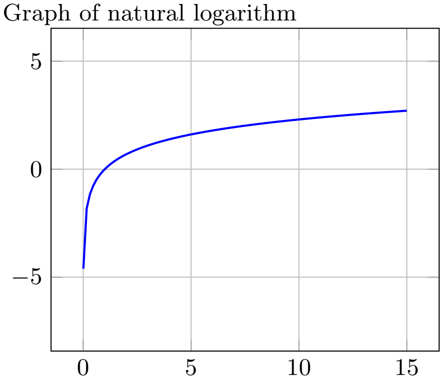
Graph Translations

For the graph of $F(x, y) = 0$

- The graph of $F(x - h, y) = 0$ is the graph of $F(x, y) = 0$ translated h units to the right.
- The graph of $F(x, y - k) = 0$ is the graph of $F(x, y) = 0$ translated k units up.
- The graph of $F(x/c, y) = 0$ is the graph of $F(x, y) = 0$ stretched a factor of c horizontally.
- The graph of $F(x, y/c) = 0$ is the graph of $F(x, y) = 0$ stretched a factor of c vertically.

Graphs

Graph of natural logarithm



Graph of natural exponential