Table of mathematical symbols

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For the HTML codes of mathematical symbols see mathematical HTML. Note: This article contains special characters.

The following table lists many specialized symbols commonly used in mathematics.

Basic mathematical symbols

	Name		
Symbol	Read as	Explanation	Examples
	Category		
	equality	1	
=	is equal to; equals	x = y means x and y represent the same thing or value.	1 + 1 = 2
	everywhere		
#	inequation	$x \neq y$ means that x and y do not represent the	
<>	is not equal to; does not equal	same thing or value. (<i>The symbols</i> != and <> are primarily from computer science. They	1 ≠ 2
!=	everywhere	are avoided in mathematical texts.)	
<	strict inequality	r < v means r is less	
>	is less than, is greater than, is much less than, is much greater than	than y. x > y means x is greater than y. $x \ll y$ means x is much less than y. $x \gg y$ means x is much greater than y.	3 < 4 5 > 4. $0.003 \ll 1000000$
\gg	order theory	greater than y.	
\leq	inequality	$x \leq y$ means x is less than or equal to y.	
<=	is less than or	$x \ge y$ means x is greater than or equal to	

>=	equal to, is greater than or equal to order theory	y. (The symbols <= and >= are primarily from computer science. They are avoided in mathematical texts.)	$3 \le 4 \text{ and } 5 \le 5$ $5 \ge 4 \text{ and } 5 \ge 5$
x	proportionality is proportional to; varies as everywhere	$y \propto x$ means that $y = kx$ for some constant k.	if $y = 2x$, then $y \propto x$
	addition plus arithmetic	4 + 6 means the sum of 4 and 6.	2 + 7 = 9
+	disjoint union the disjoint union of and set theory	$A_1 + A_2$ means the disjoint union of sets A_1 and A_2 .	$\begin{split} A_1 &= \{1, 2, 3, 4\} \land A_2 = \{2, 4, 5, 7\} \Rightarrow \\ A_1 &+ A_2 = \{(1, 1), (2, 1), (3, 1), (4, 1), (2, 2), \\ (4, 2), (5, 2), (7, 2)\} \end{split}$
_	subtraction minus arithmetic	9 – 4 means the subtraction of 4 from 9.	8 - 3 = 5
	negative sign negative ; minus arithmetic	-3 means the negative of the number 3.	-(-5) = 5
	set-theoretic complement minus; without set theory	A - B means the set that contains all the elements of A that are not in B.	$\{1,2,4\} - \{1,3,4\} = \{2\}$
	multiplication times arithmetic	3×4 means the multiplication of 3 by 4.	7 × 8 = 56
×	Cartesian product the Cartesian product of and; the direct product of and set theory	$X \times Y$ means the set of all ordered pairs with the first element of each pair selected from X and the second element selected from Y.	$\{1,2\} \times \{3,4\} = \{(1,3),(1,4),(2,3),(2,4)\}$
	cross product cross vector algebra	$\mathbf{u} \times \mathbf{v}$ means the cross product of vectors \mathbf{u} and \mathbf{v}	$(1,2,5) \times (3,4,-1) =$ (-22, 16, -2)

	multiplication	$3 \cdot 4$ means the multiplication of 3 by	$7 \cdot 8 = 56$
	times		
	arithmetic	4.	
٠	dot product	$\mathbf{u} \cdot \mathbf{v}$ means the dot	
	dot	product of vectors u	$(1,2,5) \cdot (3,4,-1) = 6$
	vector algebra	and v	
•	division		$2 \div 4 - 5$
	divided by	$6 \div 3 \text{ or } 6/3 \text{ means the}$ division of 6 by 3.	12/4 = 3
/	arithmetic		127 1 = 3
	plus-minus	C + 2 magna hath C + 2	The equation $y = 5 + \sqrt{4}$ has two
	plus or minus	6 ± 3 means both $6 + 3$ and $6 - 3$.	solutions $x = 7$ and $x = 3$
+	arithmetic		solutions, $x = 7$ and $x = 5$.
<u> </u>	plus-minus	10 ± 2 or equivalently 10	If $a = 100 \pm 1$ mm, then a is ≥ 00 mm
	plus or minus	$\pm 20\%$ means the range	and $\leq 100 \pm 1$ mm, then <i>a</i> is ≥ 99 mm
	measurement	10 - 2 to $10 + 2$.	
	minus-plus	$6 \pm (3 \ 5)$ means both 6 + (3 - 5) and $6 - (3 + 5)$	$\cos(x \pm y) = \cos(x)\cos(y) \sin(x)\sin(y).$
Ŧ	minus or plus		
	arithmetic	5).	
	square root		
	the principal square root of; square root	\sqrt{x} means the positive number whose square is <i>x</i> .	$\sqrt{4} = 2$
	real numbers		
\checkmark	complex square root	:6	
	the complex square root of	If $z = r \exp(i\varphi)$ is represented in polar coordinates with $-\pi < \varphi$	$\sqrt{(-1)} = i$
	square root	$\leq \pi$, then $\sqrt{z} = \sqrt{r} \exp(\frac{i\pi}{2})$	
	complex	(<i>i</i> φ/2).	
			3 - 3
	absolute value or modulus	x means the distance along the real line (or	-5 = 5
	absolute value (modulus) of	across the complex plane) between <i>x</i> and	<i>i</i> = 1
	numbers	zero.	3 + 4i = 5
	Euclidean distance		
	Euclidean distance	$ \mathbf{x} - \mathbf{y} $ means the	For $x = (1,1)$, and $y = (4,5)$,

	between; Euclidean norm of Geometry	Euclidean distance between x and y .	$ \mathbf{x} - \mathbf{y} = \sqrt{([1-4]^2 + [1-5]^2)} = 5$
	Determinant determinant of Matrix theory	lAl means the determinant of the matrix A	$\begin{vmatrix} 1 & 2 \\ 2 & 4 \end{vmatrix} = 0$
I	divides divides Number Theory	A single vertical bar is used to denote divisibility. <i>alb</i> means <i>a</i> divides <i>b</i> .	Since $15 = 3 \times 5$, it is true that $3 15$ and $5 15$.
!	factorial factorial combinatorics	n ! is the product 1 × $2 \times \times n$.	$4! = 1 \times 2 \times 3 \times 4 = 24$
Т	transpose transpose matrix operations	Swap rows for columns	$A_{ij} = (A^T)_{ji}$
~	probability distribution has distribution statistics	$X \sim D$, means the random variable X has the probability distribution D.	X ~ N(0,1), the standard normal distribution
	is row equivalence to Matrix theory	A~B means that B can be generated by using a series of elementary row operations on A	$\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix} \sim \begin{bmatrix} 1 & 2 \\ 0 & 0 \end{bmatrix}$
⇒	material implication	$A \Rightarrow B$ means if A is true then B is also true; if A is false then nothing is said about B.	
\rightarrow	implies; if then	 → may mean the same as ⇒, or it may have the meaning for functions given below. 	$x = 2 \Rightarrow x^2 = 4$ is true, but $x^2 = 4 \Rightarrow x = 2$ is in general false (since x could be -2).
\supset	propositional logic, Heyting algebra	⊃ may mean the same as ⇒, or it may have the meaning for superset given below.	
\Leftrightarrow	material equivalence if and only if; iff	$A \Leftrightarrow B$ means A is true if B is true and A is false if B is false.	$x + 5 = y + 2 \iff x + 3 = y$

\leftrightarrow	propositional logic			
	logical negation	The statement $\neg A$ is true if and only if <i>A</i> is false.		
-	not	A slash placed through another operator is the same as "¬" placed in	$\neg(\neg A) \Leftrightarrow A$ $r \neq v \iff \neg(r = v)$	
~		front.	$x + y \Leftrightarrow ((x - y))$	
	propositional logic	(The symbol ~ has many other uses, so ¬ or the slash notation is preferred.)		
	logical conjunction or meet in a lattice	The statement $A \wedge B$ is true if A and B are both true; else it is false.		
Λ	and; min	For functions $A(x)$ and	$n < 4 \land n > 2 \Leftrightarrow n = 3$ when n is a natural number.	
	propositional logic, lattice theory	$B(x), A(x) \wedge B(x)$ is used to mean min(A(x), B(x)).		
	logical disjunction or join in a lattice	The statement $A \lor B$ is true if A or B (or both) are true; if both are false, the statement is		
V	or; max	false.	$n \ge 4 \lor n \le 2 \Leftrightarrow n \neq 3$ when <i>n</i> is a natural number.	
	propositional logic, lattice theory	For functions $A(x)$ and $B(x)$, $A(x) \lor B(x)$ is used to mean max(A (x), B(x)).		
	exclusive or	The statement $A \oplus B$ is		
	XOr	true when either A or B, but not both, are	$(\neg A) \oplus A$ is always true, $A \oplus A$ is	
Ð	logic, Boolean algebra	true. A B means the same.	always false.	
	direct sum	The direct sum is a special way of combining several one	Most commonly, for vector spaces U, V , and W , the following consequence is used: $U = V \oplus W \Leftrightarrow (U = V + W) \land (V \cap W =$	
	direct sum of	modules into one general module (the		
	Abstract algebra	only for logic).	Ø)	
	universal quantification		$\forall n \in : n^2 \ge n.$	
	for all; for any;	$\forall x: P(x)$ means $P(x)$ is		

	for each	true for all <i>x</i> .	
V	predicate logic		
	existential quantification	$\exists x: P(x)$ means there is	$\exists n \subset \cdot n$ is even
	there exists	at least one x such that $P(x)$ is true.	$\square n \in n$ is even.
	predicate logic		
	uniqueness quantification	$\exists ! x: P(x)$ means there	
1	there exists exactly one	is exactly one x such that $P(x)$ is true.	$\exists ! n \in : n + 5 = 2n.$
	predicate logic		
:=	definition	$x := y \text{ or } x \equiv y \text{ means } x$ is defined to be another name for y	
≡	is defined as	(Some writers use \equiv to mean congruence)	$\cosh x := (1/2)(\exp x + \exp(-x))$
		mean congrachee).	$A \text{ xor } B :\Leftrightarrow (A \lor B) \land \neg (A \land B)$
:⇔	everywhere	$P :\Leftrightarrow Q$ means P is defined to be logically equivalent to Q.	
	congruence	△ABC △DEF means	
	is congruent to	congruent to (has the	
	geometry	triangle DEF.	
	congruence relation		
≡	is congruent to modulo	$a \equiv b \pmod{n}$ means a - b is divisible by n	$5 \equiv 11 \pmod{3}$
	modular arithmetic		
	set brackets	$\{a,b,c\}$ means the set	
$\{ \ , \}$	the set of	consisting of a, b , and	$= \{ 1, 2, 3, \dots \}$
	set theory	· ·	
{:}	set builder notation	$\{x : P(x)\}$ means the set of all x for which $P(x)$	
	the set of such that	is true. $\{x \mid P(x)\}$ is the same as $\{x : P(x)\}$.	$\{n \in : n^2 < 20\} = \{1, 2, 3, 4\}$
{ }	set theory		
Ø	empty set	\varnothing means the set with	$(n + 1 < n^2 < 4)$
	the empty set	no elements. { } means the same.	$\{n \in : 1 < n^- < 4\} = \emptyset$

{ }	set theory		
€	set membership is an element of; is not an element of everywhere, set theory	$a \in S$ means a is an element of the set S ; $a \notin S$ means a is not an element of S .	$(1/2)^{-1} \in 2^{-1} \notin$
C	subset is a subset of	(subset) $A \subseteq B$ means every element of A is also element of B. (proper subset) $A \subseteq B$ means $A \subseteq B$ but $A \neq B$.	$(A \cap B) \subseteq A$
C	set theory	(Some writers use the symbol \subset as if it were the same as \subseteq .)	C
	superset	$A \supseteq B$ means every element of B is also element of A.	
	is a superset of	$A \supseteq B$ means $A \supseteq B$ but $A \neq B$.	$(A \cup B) \supseteq B$ \supset
	set theory	(Some writers use the symbol \supseteq as if it were the same as \supseteq .)	
	set-theoretic union	(exclusive) $A \cup B$ means the set that contains all the elements from A, or all	
U	the union of and union	the elements from B , but not both. "A or B , but not both." (inclusive) $A \cup B$ means the set that contains all the elements from A , or all the elements from B , or all the elements from	$A \subseteq B \Leftrightarrow (A \cup B) = B$ (inclusive)
	set theory	both A and B. "A or B or both".	
	intersected with;	$A \cap B$ means the set that contains all those elements that A and B	${x \in : x^2 = 1} \cap = {1}$

0	intersect	have in common.	
	set theory		
	symmetric difference	$A\Delta B$ means the set of	
Δ	symmetric difference	elements in exactly one of <i>A</i> or <i>B</i> .	$\{1,5,6,8\} \Delta \{2,5,8\} = \{1,2,6\}$
	set theory		
	set-theoretic complement	A B means the set that contains all those	(1234) $(3456) - (12)$
	minus; without	elements of A that are	$\{1,2,3,4\}$ $\{3,4,3,0\} - \{1,2\}$
	set theory	not in <i>B</i> .	
	function application	f(x) means the value of the function for the	15% (2) (2) (2) (2) (2) (2)
	of	element <i>x</i> .	If $f(x) := x^{-}$, then $f(3) = 3^{-} = 9$.
()	set theory		
	precedence grouping	Perform the operations	(8/4)/2 = 2/2 = 1 but $8/(4/2) = 8/2 = 4$
	parentheses	first.	$(0/4)/2 = 2/2 = 1$, but $\delta/(4/2) = \delta/2 = 4$.
	everywhere		
$f: X \to Y$	function arrow	$f: X \to Y$ means the function f maps the set X into the set Y.	Let $f: \rightarrow$ be defined by $f(x) := x^2$.
	from to		
	set theory,type theory		
	function composition	fog is the function, such that $(fog)(x) = f(g(x))$.	if $f(x) := 2x$, and $g(x) := x + 3$, then (fog) (x) = 2(x + 3).
0	composed with		
	set theory		
	natural numbers	N means { 1, 2, 3,},	
	Ν	but see the article on natural numbers for a	$= \{ a : a \in a \neq 0 \}$
N	numbers	different convention.	
	integers	means $\{, -3, -2,, -3, -2,, -3,, -2,,$	
	Z	-1, 0, 1, 2, 3, and $+$ means {1, 2, 3,}	$= \{p, -p : p \in \} \cup \{0\}$
Ζ	numbers	}= .	
	rational numbers		
	Q means $\{p/q : p \in , $	means $\{p/q : p \in , q \in \}$.	3.14000 ∈
Q	numbers		π

	real numbers		
	R	means the set of real numbers.	$\pi \in$
R	numbers		√(-1)
	complex numbers	means $\{a + b i :$	• /(1) -
	С	$a,b \in \}.$	$t = \sqrt{(-1)} \in$
	numbers		
С	arbitrary constant	<i>C</i> can be any number, most likely unknown; usually occurs when	if $f(x) = 6x^2 + 4x$, then $F(x) = 2x^3 + 2x^2 + $
	C integral calculus	calculating antiderivatives.	C, where $F'(x) = f(x)$
	1 1		$x^2 \in \mathbb{C} \forall x \in \mathbb{K}$
	real or complex numbers		because
		K means the statement	2
	ĸ	holds substituting K for P and also for C	$x^2 \in \mathbb{C} \forall x \in \mathbb{R}$
Κ		K and also for C .	and
	linear algebra		$x^2 \in \mathbb{C} \forall x \in \mathbb{C}$
	infinity	∞ is an element of the	
∞	infinity	extended number line that is greater than all real numbers: it often	$\lim_{x \to 0} 1/ x = \infty$
	numbers	occurs in limits.	
	norm		
пп	norm of	x is the norm of the element x of a normed vector space.	$ x + y \le x + y $
	length of		
	linear algebra	_	
	summation		4
\sum	sum over from to of	$\sum_{k=1}^{n} a_k \operatorname{means} a_1 + a_2 + $	$\sum_{k=1}^{1} k^2 = 1^2 + 2^2 + 3^2 + 4^2$
	arithmetic	$\dots + a_n$.	= 1 + 4 + 9 + 16 = 30
	product		4
TT	product over from to of	$\prod_{k=1}^n a_{k \text{ means}}$	$\prod_{k=1}^{n} (k+2) = (1+2)(2+2)(3+2)(4+2)$
11	arithmetic	$a_1 a_2 \cdots a_n$.	$= 3 \times 4 \times 5 \times 6 = 360$
	Cartesian product		

	the Cartesian product of; the direct product of set theory	$\prod_{i=0}^{n} Y_i \text{ means the set of} \\ \text{all (n+1)-tuples} \\ (y_0, \dots, y_n).$	$\prod_{n=1}^{3} \mathbb{R} = \mathbb{R} \times \mathbb{R} \times \mathbb{R} = \mathbb{R}^{3}$
	coproduct coproduct over from to of category theory		
	derivative	f'(x) is the derivative of the function <i>f</i> at the	
•	prime derivative of calculus	point x, i.e., the slope of the tangent to f at x. The dot notation indicates a time derivative. That is $\dot{x}(t) = \frac{\partial}{\partial t}x(t)$.	If $f(x) := x^2$, then $f'(x) = 2x$
ſ	indefinite integral or antiderivative indefinite integral of the antiderivative of calculus	$\int f(x) dx \text{ means a}$ function whose derivative is <i>f</i> .	$\int x^2 d_x = x^{3/3} + C$
	definite integral integral from to of with respect to calculus	$\int_{a}^{b} f(x) d_x \text{ means the}$ signed area between the <i>x</i> -axis and the graph of the function <i>f</i> between x = a and $x = b$.	$\int_0^b x^2 d_x = b^{3/3};$
∇	gradient del, nabla, gradient of	$\nabla f(\mathbf{x}_1,, \mathbf{x}_n)$ is the vector of partial derivatives $(\mathcal{J} / \mathcal{X}_1,, \mathcal{X}_n)$	If $f(x,y,z) := 3xy + z^2$, then $\nabla f = (3y, 3x, 2z)$
	calculus	$\partial / \partial x_n$).	
∂	partial differential partial, d	with $f(x_1,, x_n)$, $\partial f / \partial x_i$ is the derivative of f with respect to x_i , with all other variables	If $f(x,y) := x^2 y$, then $\partial f' \partial x = 2xy$
	boundary	kept constant.	

	boundary of topology	∂M means the boundary of M	$\partial \{ x : x \le 2 \} = \{ x : x = 2 \}$
	perpendicular is perpendicular to geometry	$x \perp y$ means x is perpendicular to y; or more generally x is orthogonal to y.	If $l \perp m$ and $m \perp n$ then $l \parallel n$.
	bottom element		
	the bottom element	$x = \perp$ means x is the smallest element.	$\forall x: x \land \bot = \bot$
	lattice theory		
	parallel	$x \parallel y$ means x is parallel	
	is parallel to	to y.	If $l \parallel m$ and $m \perp n$ then $l \perp n$.
	geometry		
	entailment	A B means the sentence A entails the	
	entails	sentence <i>B</i> , that is every model in which <i>A</i>	$A A \lor \neg A$
	model theory	is true, B is also true.	
	inference		
	infers or is derived from	x y means y is derived from x.	$A \to B \neg B \to \neg A$
	propositional logic, predicate logic		
	normal subgroup	N G means that N is a normal subgroup of group G	Z(G) G
	is a normal subgroup of		
	group theory	8F	
	quotient group	<i>G</i> / <i>H</i> means the quotient	(0, a, 2a, b, b) = b(2a) / (0, b) = ((0, b))
	mod	of group G modulo its	$\{0, a, 2a, b, b+a, b+2a\} / \{0, b\} = \{\{0, b\}, \{a, b+a\}, \{2a, b+2a\}\}$
/	group theory	subgroup <i>H</i> .	
	quotient set	A/~ means the set of all	If we define \sim by $x \sim y \Leftrightarrow x - y \in \mathbb{Z}$, then
	mod	\sim equivalence classes in	$\mathbf{R}/\sim = \{\{x+n : n \in \mathbf{Z}\} : x \in \{0,1\}\}$
	set theory	л.	
	isomorphism	$G \approx H$ means that	$Q/\{1,-1\}\approx V,$
	is isomorphic to	group G is isomorphic	where Q is the quaternion group and V is the Klein four-group
_	group theory	Stoup II	and from four group.
\approx	approximately equal	$x \approx y$ means x is	
	is approximately equal to	approximately equal to <i>y</i>	$\pi \approx 3.14159$
	everywhere		

~	same order of magnitude roughly similar poorly approximates Approximation theory	$m \sim n$, means the quantities m and n have the general size. (Note that ~ is used for an approximation that is poor, otherwise use \approx .)	$2 \sim 5$ $8 \times 9 \sim 100$ but $\pi^2 \approx 10$
\langle , \rangle	inner product		
()		inner product of <i>x</i> and <i>y</i> as defined in an inner product space.	The standard inner product between two vectors $x = (2, 3)$ and $y = (-1, 5)$ is: $\langle x, y \rangle = 2 \times -1 + 3 \times 5 = 13$
<,>	inner product of	For spatial vectors, the dot product notation, $x \cdot y$ is common.	$A:B = \sum_{i,j} A_{ij}B_{ij}$
• •	vector algebra	notation may be used.	
	tensor product		
	tensor product of	V U means the tensor product of V and U.	$\{1, 2, 3, 4\} \{1, 1, 2\} = \\ \{\{1, 2, 3, 4\}, \{1, 2, 3, 4\}, \{2, 4, 6, 8\}\}$
	linear algebra	r	
*	convolution	f * g means the	$(f * a)(t) = \int f(\tau) a(t - \tau) d\tau$
	convolution	convolution of f and g .	(3 - 5)(-) - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -
_	mean	\bar{x} is the mean (average	
\overline{x}	overbar	value of x_i).	$x = \{1, 2, 3, 4, 5\}; x = 3.$
	statistics	A	
	delta equal to	\triangleq means equal by definition. When \triangleq is	
≜	equal by definition	true generally, but rather equality is true under certain	$p(x_1, x_2,, x_n) \triangleq \prod_{i=1}^n p(x_i x_{\pi_i}).$
	everywhere	assumptions that are taken in context.	

See also

• Mathematical alphanumeric symbols

- Table of logic symbols
- Physical constants
- Variables commonly used in physics
- **ISO 31-11**

External links

- Jeff Miller: *Earliest Uses of Various Mathematical Symbols* (http://members.aol.com/jeff570/mathsym.html)
- TCAEP Institute of Physics (http://www.tcaep.co.uk/science/symbols/maths.htm)
- GIF and PNG Images for Math Symbols (http://us.metamath.org/symbols/symbols.html)

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