

Mathematical Operators

Range: 2200–22FF

This file contains an excerpt from the character code tables and list of character names for *The Unicode Standard, Version 3.0*.

Disclaimer

The shapes of the reference glyphs used in these code charts are not prescriptive. Considerable variation is to be expected in actual fonts.

For a complete understanding of the use of the characters contained in this excerpt file, please consult the appropriate sections of *The Unicode Standard, Version 3.0* (ISBN 0-201-61633-5), as well as the Unicode Technical Reports and the Unicode Character Database, which are available online.

See <http://www.unicode.org/Public/UNIDATA/UnicodeCharacterDatabase.html> and <http://www.unicode.org/unicode/reports>

A thorough understanding of the information contained in these additional sources is required for a successful implementation.

Fonts

The fonts used in these charts were provided to the Unicode Consortium by a number of different font designers

See <http://www.unicode.org/unicode/uni2book/u2fonts.html> for a list.

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See <http://www.unicode.org/pending/pending.html> and <http://www.unicode.org/unicode/alloc/Pipeline.html>.

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	220	221	222	223	224	225	226	227
0	∇ 2200	\sqcup 2210	\sphericalangle 2220	\mathfrak{F} 2230	\wr 2240	\doteq 2250	\neq 2260	$\not\approx$ 2270
1	\complement 2201	Σ 2211	Δ 2221	\mathfrak{f} 2231	\approx 2241	\div 2251	\equiv 2261	$\not\equiv$ 2271
2	∂ 2202	$-$ 2212	\times 2222	\mathfrak{f} 2232	\approx 2242	\doteq 2252	\neq 2262	\approx 2272
3	\exists 2203	\mp 2213	$ $ 2223	\mathfrak{f} 2233	\approx 2243	\doteq 2253	\equiv 2263	\approx 2273
4	\cancel{A} 2204	\dagger 2214	\dagger 2224	\therefore 2234	\neq 2244	\doteq 2254	\leq 2264	$\not\approx$ 2274
5	\emptyset 2205	$/$ 2215	\parallel 2225	\therefore 2235	\equiv 2245	\doteq 2255	\geq 2265	$\not\approx$ 2275
6	Δ 2206	\setminus 2216	\mathfrak{K} 2226	$:$ 2236	\mathfrak{H} 2246	\mathfrak{H} 2256	\equiv 2266	\approx 2276
7	∇ 2207	$*$ 2217	\wedge 2227	\therefore 2237	\mathfrak{H} 2247	\doteq 2257	\equiv 2267	\approx 2277
8	\in 2208	\circ 2218	\vee 2228	$\dot{-}$ 2238	\approx 2248	\doteq 2258	\mathfrak{H} 2268	\mathfrak{H} 2278
9	\notin 2209	\bullet 2219	\cap 2229	$\dot{-}$ 2239	\mathfrak{H} 2249	\doteq 2259	\mathfrak{H} 2269	\mathfrak{H} 2279
A	ϵ 220A	$\sqrt{\quad}$ 221A	\cup 222A	\doteq 223A	\approx 224A	\leq 225A	\ll 226A	\lessgtr 227A
B	\supseteq 220B	$\sqrt[3]{\quad}$ 221B	\int 222B	\div 223B	\approx 224B	\star 225B	\gg 226B	\succ 227B
C	\cancel{A} 220C	$\sqrt[4]{\quad}$ 221C	\iint 222C	\sim 223C	\equiv 224C	\triangle 225C	\emptyset 226C	\succ 227C
D	\ni 220D	∞ 221D	\iiint 222D	\sim 223D	\asymp 224D	$\stackrel{\text{def}}{=}$ 225D	\mathfrak{H} 226D	\approx 227D
E	\blacksquare 220E	∞ 221E	\mathfrak{f} 222E	\approx 223E	\mathfrak{H} 224E	\equiv 225E	\mathfrak{H} 226E	\approx 227E
F	\prod 220F	\perp 221F	\mathfrak{F} 222F	\sim 223F	\mathfrak{H} 224F	$\stackrel{?}{=}$ 225F	\mathfrak{H} 226F	\approx 227F

	228	229	22A	22B	22C	22D	22E	22F
0	2280	2290	22A0	22B0	22C0	22D0	22E0	22F0
1	2281	2291	22A1	22B1	22C1	22D1	22E1	22F1
2	2282	2292	22A2	22B2	22C2	22D2	22E2	
3	2283	2293	22A3	22B3	22C3	22D3	22E3	
4	2284	2294	22A4	22B4	22C4	22D4	22E4	
5	2285	2295	22A5	22B5	22C5	22D5	22E5	
6	2286	2296	22A6	22B6	22C6	22D6	22E6	
7	2287	2297	22A7	22B7	22C7	22D7	22E7	
8	2288	2298	22A8	22B8	22C8	22D8	22E8	
9	2289	2299	22A9	22B9	22C9	22D9	22E9	
A	228A	229A	22AA	22BA	22CA	22DA	22EA	
B	228B	229B	22AB	22BB	22CB	22DB	22EB	
C	228C	229C	22AC	22BC	22CC	22DC	22EC	
D	228D	229D	22AD	22BD	22CD	22DD	22ED	
E	228E	229E	22AE	22BE	22CE	22DE	22EE	
F	228F	229F	22AF	22BF	22CF	22DF	22EF	

Mathematical operators

2200	∀	FOR ALL	2217	*	ASTERISK OPERATOR → 002A * asterisk
2201	∁	COMPLEMENT → 0297 ∁ latin letter stretched c	2218	◦	RING OPERATOR = composite function = APL jot → 00B0 ° degree sign → 25E6 ◦ white bullet
2202	∂	PARTIAL DIFFERENTIAL	2219	•	BULLET OPERATOR → 00B7 • middle dot → 2022 • bullet → 2024 . one dot leader
2203	∃	THERE EXISTS	221A	√	SQUARE ROOT = radical sign → 2713 ✓ check mark
2204	∄	THERE DOES NOT EXIST ≡ 2203 ∃ 0338 ∄	221B	∛	CUBE ROOT
2205	∅	EMPTY SET = null set → 00D8 Ø latin capital letter o with stroke → 2300 ∅ diameter sign	221C	∜	FOURTH ROOT
2206	Δ	INCREMENT = Laplace operator = forward difference → 0394 Δ greek capital letter delta → 25B3 Δ white up-pointing triangle	221D	∞	PROPORTIONAL TO → 03B1 α greek small letter alpha
2207	∇	NABLA = Laplace operator (written with superscript 2) = backward difference = del → 25BD ∇ white down-pointing triangle	221E	∞	INFINITY
2208	∈	ELEMENT OF	221F	⊥	RIGHT ANGLE
2209	∉	NOT AN ELEMENT OF ≡ 2208 ∈ 0338 ∄	2220	∠	ANGLE
220A	∈	SMALL ELEMENT OF • originates in math pi fonts; not the straight epsilon	2221	∠	MEASURED ANGLE
220B	⊃	CONTAINS AS MEMBER = such that	2222	∠	SPHERICAL ANGLE = angle arc
220C	⊄	DOES NOT CONTAIN AS MEMBER ≡ 220B ⊃ 0338 ∄	2223		DIVIDES = such that = APL stile → 007C vertical line → 01C0 latin letter dental click
220D	⊃	SMALL CONTAINS AS MEMBER	2224	∤	DOES NOT DIVIDE ≡ 2223 0338 ∄
220E	■	END OF PROOF = Q.E.D. → 2023 ▶ triangular bullet → 25AE ■ black vertical rectangle	2225	∥	PARALLEL TO → 01C1 ∥ latin letter lateral click → 2016 ∥ double vertical line
220F	∏	N-ARY PRODUCT = product sign → 03A0 ∏ greek capital letter pi	2226	∦	NOT PARALLEL TO ≡ 2225 ∥ 0338 ∄
2210	∐	N-ARY COPRODUCT = coproduct sign	2227	∧	LOGICAL AND = wedge, conjunction → 22C0 ∧ n-ary logical and → 2303 ^ up arrowhead
2211	∑	N-ARY SUMMATION = summation sign → 03A3 ∑ greek capital letter sigma	2228	∨	LOGICAL OR = vee, disjunction → 22C1 ∨ n-ary logical or → 2304 ∨ down arrowhead
2212	-	MINUS SIGN → 002D - hyphen-minus	2229	∩	INTERSECTION = cap, hat → 22C2 ∩ n-ary intersection
2213	±	MINUS-OR-PLUS SIGN → 00B1 ± plus-minus sign	222A	∪	UNION = cup → 22C3 ∪ n-ary union
2214	+	DOT PLUS	222B	∫	INTEGRAL → 0283 ∫ latin small letter esh
2215	/	DIVISION SLASH • generic division operator → 002F / solidus → 2044 / fraction slash	222C	∬	DOUBLE INTEGRAL ≈ 222B ∫ 222B ∫
2216	\	SET MINUS → 005C \ reverse solidus	222D	∭	TRIPLE INTEGRAL ≈ 222B ∫ 222B ∫ 222B ∫
			222E	∮	CONTOUR INTEGRAL

222F	\int SURFACE INTEGRAL ≈ 222E \int 222E \int	224C	\equiv ALL EQUAL TO • reversed tilde and lazy S are glyph variants
2230	\iiint VOLUME INTEGRAL ≈ 222E \int 222E \int 222E \int	224D	\asymp EQUIVALENT TO
2231	\oint CLOCKWISE INTEGRAL	224E	\simeq GEOMETRICALLY EQUIVALENT TO
2232	\oint CLOCKWISE CONTOUR INTEGRAL	224F	\doteq DIFFERENCE BETWEEN
2233	\oint ANTICLOCKWISE CONTOUR INTEGRAL • clockwise or anticlockwise arrows do not reverse during layout mirroring	2250	\doteq APPROACHES THE LIMIT
2234	\therefore THEREFORE	2251	\doteq GEOMETRICALLY EQUAL TO
2235	\because BECAUSE	2252	\doteq APPROXIMATELY EQUAL TO OR THE IMAGE OF = nearly equals
2236	$:$ RATIO → 003A : colon	2253	\doteq IMAGE OF OR APPROXIMATELY EQUAL TO
2237	$::$ PROPORTION	2254	\doteq COLON EQUALS
2238	$\dot{-}$ DOT MINUS = symmetric difference	2255	\doteq EQUALS COLON
2239	\therefore EXCESS	2256	\doteq RING IN EQUAL TO
223A	\doteq GEOMETRIC PROPORTION	2257	\doteq RING EQUAL TO = approximately equal to
223B	\doteq HOMOTHETIC	2258	\doteq CORRESPONDS TO
223C	\sim TILDE OPERATOR = varies with (proportional to) = difference between = similar to = not = cycle = APL tilde → 007E ~ tilde → 00AC ¬ not sign → 02DC ~ small tilde	2259	\doteq ESTIMATES = corresponds to
223D	$\tilde{}$ REVERSED TILDE = lazy S • reversed tilde and lazy S are glyph variants	225A	\doteq EQUIANGULAR TO
223E	\sim INVERTED LAZY S = most positive	225B	\doteq STAR EQUALS
223F	\sim SINE WAVE = alternating current	225C	\doteq DELTA EQUAL TO = equiangular = equal to by definition
2240	\wr WREATH PRODUCT	225D	\doteq EQUAL TO BY DEFINITION
2241	\ncong NOT TILDE ≡ 223C ~ 0338 $\not\sim$	225E	\doteq MEASURED BY
2242	\approx MINUS TILDE	225F	\doteq QUESTIONED EQUAL TO
2243	\approx ASYMPTOTICALLY EQUAL TO	2260	\neq NOT EQUAL TO → 003D = equals sign → 01C2 † latin letter alveolar click ≡ 003D = 0338 $\not\neq$
2244	$\not\approx$ NOT ASYMPTOTICALLY EQUAL TO ≡ 2243 ≈ 0338 $\not\approx$	2261	\equiv IDENTICAL TO
2245	\doteq APPROXIMATELY EQUAL TO	2262	$\not\equiv$ NOT IDENTICAL TO ≡ 2261 ≡ 0338 $\not\equiv$
2246	\doteq APPROXIMATELY BUT NOT ACTUALLY EQUAL TO	2263	\equiv STRICTLY EQUIVALENT TO
2247	$\not\equiv$ NEITHER APPROXIMATELY NOR ACTUALLY EQUAL TO ≡ 2245 ≡ 0338 $\not\equiv$	2264	\leq LESS-THAN OR EQUAL TO
2248	\approx ALMOST EQUAL TO = asymptotic to	2265	\geq GREATER-THAN OR EQUAL TO
2249	$\not\approx$ NOT ALMOST EQUAL TO ≡ 2248 ≈ 0338 $\not\approx$	2266	\leq LESS-THAN OVER EQUAL TO
224A	\approx ALMOST EQUAL OR EQUAL TO	2267	\geq GREATER-THAN OVER EQUAL TO
224B	\approx TRIPLE TILDE	2268	\leq LESS-THAN BUT NOT EQUAL TO
		2269	\geq GREATER-THAN BUT NOT EQUAL TO
		226A	\ll MUCH LESS-THAN → 00AB « left-pointing double angle quotation mark
		226B	\gg MUCH GREATER-THAN → 00BB » right-pointing double angle quotation mark
		226C	∇ BETWEEN = plaintiff, quantic
		226D	$\not\asymp$ NOT EQUIVALENT TO ≡ 224D \asymp 0338 $\not\asymp$
		226E	\nless NOT LESS-THAN ≡ 003C < 0338 \nless
		226F	\ngtr NOT GREATER-THAN ≡ 003E > 0338 \ngtr

2270	\nless NEITHER LESS-THAN NOR EQUAL TO = 2264 \leq 0338 $\not\neq$	228F	\square SQUARE IMAGE OF
2271	\ngtr NEITHER GREATER-THAN NOR EQUAL TO = 2265 \geq 0338 $\not\neq$	2290	\sqsubset SQUARE ORIGINAL OF
2272	\lessdot LESS-THAN OR EQUIVALENT TO	2291	\sqsubseteq SQUARE IMAGE OF OR EQUAL TO
2273	\gtrdot GREATER-THAN OR EQUIVALENT TO	2292	\sqsupset SQUARE ORIGINAL OF OR EQUAL TO
2274	\nlessdot NEITHER LESS-THAN NOR EQUIVALENT TO = 2272 \leq 0338 $\not\neq$	2293	\sqcap SQUARE CAP
2275	\ngtrdot NEITHER GREATER-THAN NOR EQUIVALENT TO = 2273 \geq 0338 $\not\neq$	2294	\sqcup SQUARE CUP
2276	\lessgtr LESS-THAN OR GREATER-THAN	2295	\oplus CIRCLED PLUS = direct sum = vector pointing into page → 2641 \odot earth
2277	\gtrless GREATER-THAN OR LESS-THAN	2296	\ominus CIRCLED MINUS = symmetric difference
2278	\nlessgtr NEITHER LESS-THAN NOR GREATER-THAN = 2276 \leq 0338 $\not\neq$	2297	\otimes CIRCLED TIMES = tensor product = vector pointing into page
2279	\ngtrless NEITHER GREATER-THAN NOR LESS-THAN = 2277 \geq 0338 $\not\neq$	2298	\oslash CIRCLED DIVISION SLASH
227A	$<$ PRECEDES = lower rank than → 22B0 \prec precedes under relation	2299	\odot CIRCLED DOT OPERATOR = direct product = vector pointing out of page → 0298 \odot latin letter bilabial click → 2609 \odot sun
227B	$>$ SUCCEEDS = higher rank than → 22B1 \succ succeeds under relation	229A	\odot CIRCLED RING OPERATOR → 233E \odot apl functional symbol circle jot → 25CE \odot bullseye
227C	\lessdot PRECEDES OR EQUAL TO	229B	\oplus CIRCLED ASTERISK OPERATOR
227D	\gtrdot SUCCEEDS OR EQUAL TO	229C	\equiv CIRCLED EQUALS
227E	\lessdot PRECEDES OR EQUIVALENT TO	229D	\ominus CIRCLED DASH
227F	\gtrdot SUCCEEDS OR EQUIVALENT TO	229E	\boxplus SQUARED PLUS
2280	\nlessdot DOES NOT PRECEDE = 227A $<$ 0338 $\not\neq$	229F	\boxminus SQUARED MINUS
2281	\ngtrdot DOES NOT SUCCEED = 227B $>$ 0338 $\not\neq$	22A0	\boxtimes SQUARED TIMES → 2612 \boxtimes ballot box with x
2282	\subset SUBSET OF = included in set	22A1	\boxdot SQUARED DOT OPERATOR
2283	\supset SUPERSSET OF = includes in set	22A2	\vdash RIGHT TACK = turnstile = proves, implies, yields = reducible
2284	$\not\subset$ NOT A SUBSET OF = 2282 \subset 0338 $\not\neq$	22A3	\dashv LEFT TACK = reverse turnstile = non-theorem, does not yield
2285	$\not\supset$ NOT A SUPERSSET OF = 2283 \supset 0338 $\not\neq$	22A4	\top DOWN TACK = top • called up tack in APL
2286	\subseteq SUBSET OF OR EQUAL TO	22A5	\perp UP TACK = orthogonal to = perpendicular = base • called down tack in APL
2287	\supseteq SUPERSSET OF OR EQUAL TO	22A6	\vdash ASSERTION = reduces to
2288	$\not\subseteq$ NEITHER A SUBSET OF NOR EQUAL TO = 2286 \subseteq 0338 $\not\neq$	22A7	\models MODELS = satisfies
2289	$\not\supseteq$ NEITHER A SUPERSSET OF NOR EQUAL TO = 2287 \supseteq 0338 $\not\neq$	22A8	\models TRUE = statement is true, valid = is a tautology = results in
228A	\subsetneq SUBSET OF WITH NOT EQUAL TO	22A9	\Vdash FORCES = results in
228B	\supsetneq SUPERSSET OF WITH NOT EQUAL TO		
228C	\cup MULTISSET		
228D	\cup MULTISSET MULTIPLICATION		
228E	\cup MULTISSET UNION = z notation bag addition		

22AA	≡	TRIPLE VERTICAL BAR RIGHT TURNSTILE	22C9	⋈	LEFT NORMAL FACTOR SEMIDIRECT PRODUCT
22AB	≡	DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE	22CA	⋉	RIGHT NORMAL FACTOR SEMIDIRECT PRODUCT
22AC	⊄	DOES NOT PROVE ≡ 22A2 ⊢ 0338 $\not\equiv$	22CB	⋊	LEFT SEMIDIRECT PRODUCT
22AD	⊈	NOT TRUE ≡ 22A8 ⊢ 0338 $\not\equiv$	22CC	⋋	RIGHT SEMIDIRECT PRODUCT → 2041 \sphericalangle caret insertion point
22AE	⊈	DOES NOT FORCE ≡ 22A9 ⊢ 0338 $\not\equiv$	22CD	≡	REVERSED TILDE EQUALS
22AF	≡	NEGATED DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE ≡ 22AB ≡ 0338 $\not\equiv$	22CE	∨	CURLY LOGICAL OR
22B0	⋈	PRECEDES UNDER RELATION → 227A < precedes	22CF	∧	CURLY LOGICAL AND
22B1	⋉	SUCCEEDS UNDER RELATION → 227B > succeeds	22D0	⊆	DOUBLE SUBSET
22B2	◁	NORMAL SUBGROUP OF → 25C5 ◁ white left-pointing pointer	22D1	⊇	DOUBLE SUPERSET
22B3	▷	CONTAINS AS NORMAL SUBGROUP → 25BB ▷ white right-pointing pointer	22D2	∩	DOUBLE INTERSECTION
22B4	⊆	NORMAL SUBGROUP OF OR EQUAL TO	22D3	∪	DOUBLE UNION
22B5	⊇	CONTAINS AS NORMAL SUBGROUP OR EQUAL TO	22D4	∩	PITCHFORK = proper intersection
22B6	↦	ORIGINAL OF	22D5	≡	EQUAL AND PARALLEL TO → 2317 ≡ viewdata square
22B7	↗	IMAGE OF	22D6	<	LESS-THAN WITH DOT
22B8	↘	MULTIMAP	22D7	>	GREATER-THAN WITH DOT
22B9	†	HERMITIAN CONJUGATE MATRIX	22D8	≪	VERY MUCH LESS-THAN
22BA	‡	INTERCALATE	22D9	≫	VERY MUCH GREATER-THAN
22BB	⊕	XOR	22DA	≡	LESS-THAN EQUAL TO OR GREATER-THAN
22BC	⊖	NAND → 2305 ⊖ projective	22DB	≡	GREATER-THAN EQUAL TO OR LESS-THAN
22BD	∇	NOR	22DC	≡	EQUAL TO OR LESS-THAN
22BE	⊓	RIGHT ANGLE WITH ARC	22DD	≡	EQUAL TO OR GREATER-THAN
22BF	⊔	RIGHT TRIANGLE	22DE	≡	EQUAL TO OR PRECEDES
22C0	∧	N-ARY LOGICAL AND → 2227 ∧ logical and	22DF	≡	EQUAL TO OR SUCCEEDS
22C1	∨	N-ARY LOGICAL OR → 2228 ∨ logical or	22E0	≡	DOES NOT PRECEDE OR EQUAL ≡ 227C ≡ 0338 $\not\equiv$
22C2	∩	N-ARY INTERSECTION = z notation generalised intersection → 2229 ∩ intersection	22E1	≡	DOES NOT SUCCEED OR EQUAL ≡ 227D ≡ 0338 $\not\equiv$
22C3	∪	N-ARY UNION = z notation generalised union → 222A ∪ union	22E2	⊈	NOT SQUARE IMAGE OF OR EQUAL TO ≡ 2291 ⊈ 0338 $\not\equiv$
22C4	⋄	DIAMOND OPERATOR → 25C7 ⋄ white diamond	22E3	⊈	NOT SQUARE ORIGINAL OF OR EQUAL TO ≡ 2292 ⊈ 0338 $\not\equiv$
22C5	⋅	DOT OPERATOR → 00B7 ⋅ middle dot	22E4	⊈	SQUARE IMAGE OF OR NOT EQUAL TO
22C6	★	STAR OPERATOR • APL → 066D ★ arabic five pointed star → 2605 ⦿ black star	22E5	⊈	SQUARE ORIGINAL OF OR NOT EQUAL TO
22C7	∗	DIVISION TIMES	22E6	≡	LESS-THAN BUT NOT EQUIVALENT TO
22C8	⋈	BOWTIE → 2445 ⋈ ocr bow tie	22E7	≡	GREATER-THAN BUT NOT EQUIVALENT TO
			22E8	≡	PRECEDES BUT NOT EQUIVALENT TO
			22E9	≡	SUCCEEDS BUT NOT EQUIVALENT TO
			22EA	⊈	NOT NORMAL SUBGROUP OF ≡ 22B2 ◁ 0338 $\not\equiv$
			22EB	⊈	DOES NOT CONTAIN AS NORMAL SUBGROUP ≡ 22B3 ▷ 0338 $\not\equiv$

- 22EC \ncong NOT NORMAL SUBGROUP OF OR
EQUAL TO
 \equiv 22B4 \trianglelefteq 0338 $\not\equiv$
- 22ED \ncong DOES NOT CONTAIN AS NORMAL
SUBGROUP OR EQUAL
 \equiv 22B5 \trianglerighteq 0338 $\not\equiv$
- 22EE \vdots VERTICAL ELLIPSIS
• these four ellipses are used for matrix
row/column elision
→ 2026 ... horizontal ellipsis
- 22EF \cdots MIDLINE HORIZONTAL ELLIPSIS
- 22F0 $\cdot\cdot$ UP RIGHT DIAGONAL ELLIPSIS
- 22F1 $\cdot\cdot$ DOWN RIGHT DIAGONAL ELLIPSIS