

Mathematical Operators

Range: 2200–22FF

DRAFT The Unicode Standard, Version 16.0 BETA REVIEW

This file contains an excerpt from the character code tables and list of character names for *DRAFT The Unicode Standard, Version 16.0 BETA REVIEW*

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See <https://www.unicode.org/charts/> for access to a complete list of the latest character code charts. See <https://www.unicode.org/charts/PDF/Unicode-15.1/> for charts showing only the characters added in Unicode 15.1. See <https://www.unicode.org/Public/15.1.0/charts/> for a complete archived file of character code charts for Unicode 15.1. See <https://www.unicode.org/charts/About.html#Conventions> for conventions used in these code charts, and other general information.

Disclaimer

These charts are provided as the online reference to the character contents of the Unicode Standard, Version 15.1 but do not provide all the information needed to fully support individual scripts using the Unicode Standard. For a complete understanding of the use of the characters contained in this file, please consult the appropriate sections of The Unicode Standard, Version 15.1, online at <https://www.unicode.org/versions/Unicode15.1.0/>, as well as Unicode Standard Annexes #9, #11, #14, #15, #24, #29, #31, #34, #38, #41, #42, #44, #45, and #50, the other Unicode Technical Reports and Standards, and the Unicode Character Database, which are available online.

See <https://www.unicode.org/ucd/> and <http://www.unicode.org/reports/>

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

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See <https://www.unicode.org/charts/fonts.html> for a list.

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	220	221	222	223	224	225	226	227	228	229	22A	22B	22C	22D	22E	22F
0	∇ 2200	\amalg 2210	\angle 2220	\int 2230	ζ 2240	\doteq 2250	\neq 2260	\nlessgtr 2270	\nlessgtr 2280	\sqsupset 2290	\boxtimes 22A0	\wp 22B0	\bigwedge 22C0	\in 22D0	\nlessgtr 22E0	\ddots 22F0
1	\complement 2201	\sum 2211	\triangleleft 2221	f 2231	ζ 2241	\doteq 2251	\equiv 2261	\nlessgtr 2271	\nlessgtr 2281	\sqsubseteq 2291	\square 22A1	\wp 22B1	\bigvee 22C1	\supset 22D1	\nlessgtr 22E1	\ddots 22F1
2	∂ 2202	$-$ 2212	\triangleleft 2222	\oint 2232	\Rrightarrow 2242	\doteq 2252	\neq 2262	\nlessgtr 2272	\subset 2282	\sqsubseteq 2292	\top 22A2	\triangle 22B2	\cup 22C2	\supseteq 22D2	\nlessgtr 22E2	\in 22F2
3	\exists 2203	\mp 2213	$ $ 2223	\oint 2233	\Rrightarrow 2243	\doteq 2253	\equiv 2263	\nlessgtr 2273	\supset 2283	\sqsupset 2293	\top 22A3	\triangle 22B3	\cup 22C3	\supseteq 22D3	\nlessgtr 22E3	\in 22F3
4	\nlessgtr 2204	\dagger 2214	\dagger 2224	\ddots 2234	\nlessgtr 2244	\doteq 2254	\leq 2264	\nlessgtr 2274	\nlessgtr 2284	\sqsupset 2294	\top 22A4	\triangle 22B4	\diamond 22C4	\supseteq 22D4	\nlessgtr 22E4	\in 22F4
5	\emptyset 2205	$/$ 2215	\parallel 2225	\ddots 2235	\Rrightarrow 2245	\doteq 2255	\geq 2265	\nlessgtr 2275	\nlessgtr 2285	\oplus 2295	\top 22A5	\triangle 22B5	\cdot 22C5	$\#$ 22D5	\nlessgtr 22E5	\in 22F5
6	\triangle 2206	\setminus 2216	$\#$ 2226	\cdot 2236	\nlessgtr 2246	\nlessgtr 2256	\geq 2266	\nlessgtr 2276	\subset 2286	\ominus 2296	\top 22A6	\circ 22B6	\star 22C6	\nlessgtr 22D6	\nlessgtr 22E6	\in 22F6
7	∇ 2207	$*$ 2217	\wedge 2227	\ddots 2237	\nlessgtr 2247	\doteq 2257	\geq 2267	\nlessgtr 2277	\supset 2287	\otimes 2297	\top 22A7	\circ 22B7	$*$ 22C7	\nlessgtr 22D7	\nlessgtr 22E7	\in 22F7
8	\in 2208	\circ 2218	\vee 2228	\cdot 2238	\nlessgtr 2248	\doteq 2258	\nlessgtr 2268	\nlessgtr 2278	\nlessgtr 2288	\ominus 2298	\top 22A8	\circ 22B8	\otimes 22C8	\nlessgtr 22D8	\nlessgtr 22E8	\in 22F8
9	\nlessgtr 2209	\cdot 2219	\cup 2229	\cdot 2239	\nlessgtr 2249	\doteq 2259	\nlessgtr 2269	\nlessgtr 2279	\nlessgtr 2289	\odot 2299	\top 22A9	\dagger 22B9	\otimes 22C9	\nlessgtr 22D9	\nlessgtr 22E9	\in 22F9
A	\in 220A	$\sqrt{\quad}$ 221A	\cup 222A	\ddots 223A	\Rrightarrow 224A	\nlessgtr 225A	\nlessgtr 226A	\nlessgtr 227A	\nlessgtr 228A	\odot 229A	\top 22AA	\top 22BA	\otimes 22CA	\nlessgtr 22DA	\nlessgtr 22EA	\in 22FA
B	\supseteq 220B	$\sqrt[3]{\quad}$ 221B	\int 222B	\nlessgtr 223B	\nlessgtr 224B	\nlessgtr 225B	\nlessgtr 226B	\nlessgtr 227B	\nlessgtr 228B	\otimes 229B	\top 22AB	\nlessgtr 22BB	\nlessgtr 22CB	\nlessgtr 22DB	\nlessgtr 22EB	\in 22FB
C	\nlessgtr 220C	$\sqrt[4]{\quad}$ 221C	\iint 222C	\nlessgtr 223C	\nlessgtr 224C	\nlessgtr 225C	\nlessgtr 226C	\nlessgtr 227C	\nlessgtr 228C	\ominus 229C	\nlessgtr 22AC	\nlessgtr 22BC	\nlessgtr 22CC	\nlessgtr 22DC	\nlessgtr 22EC	\in 22FC
D	\supset 220D	α 221D	\iiint 222D	\nlessgtr 223D	\nlessgtr 224D	def 225D	\nlessgtr 226D	\nlessgtr 227D	\nlessgtr 228D	\ominus 229D	\nlessgtr 22AD	\nlessgtr 22BD	\nlessgtr 22CD	\nlessgtr 22DD	\nlessgtr 22ED	\in 22FD
E	\blacksquare 220E	∞ 221E	\oint 222E	\nlessgtr 223E	\nlessgtr 224E	\nlessgtr 225E	\nlessgtr 226E	\nlessgtr 227E	\nlessgtr 228E	\nlessgtr 229E	\nlessgtr 22AE	\nlessgtr 22BE	\nlessgtr 22CE	\nlessgtr 22DE	\ddots 22EE	\in 22FE
F	\amalg 220F	\perp 221F	\int 222F	\nlessgtr 223F	\nlessgtr 224F	\nlessgtr 225F	\nlessgtr 226F	\nlessgtr 227F	\nlessgtr 228F	\nlessgtr 229F	\nlessgtr 22AF	\nlessgtr 22BF	\nlessgtr 22CF	\nlessgtr 22DF	\ddots 22EF	\in 22FF

Miscellaneous mathematical symbols

- 2200 \forall FOR ALL
= universal quantifier
- 2201 \complement COMPLEMENT
→ 0297 \complement latin letter stretched c
- 2202 ∂ PARTIAL DIFFERENTIAL
- 2203 \exists THERE EXISTS
= existential quantifier
- 2204 \nexists THERE DOES NOT EXIST
≡ 2203 \exists 0338 $\not\exists$
- 2205 \emptyset EMPTY SET
= null set
• used in linguistics to indicate a null morpheme or phonological “zero”
→ 00D8 \emptyset latin capital letter o with stroke
→ 2300 \emptyset diameter sign
~ 2205 FE00 \emptyset zero with long diagonal stroke overlay form
- 2206 Δ INCREMENT
= Laplace operator
= forward difference
= symmetric difference (in set theory)
• other symbols may also be used for symmetric difference
→ 0394 Δ greek capital letter delta
→ 25B3 Δ white up-pointing triangle
- 2207 ∇ NABLA
= backward difference
= gradient, del
• used for Laplacian operator (written with superscript 2)
→ 25BD ∇ white down-pointing triangle

Set membership

- 2208 \in ELEMENT OF
- 2209 \notin NOT AN ELEMENT OF
≡ 2208 \in 0338 \notin
- 220A ϵ SMALL ELEMENT OF
• originates in math pi fonts; not the straight epsilon
→ 03F5 ϵ greek lunate epsilon symbol
- 220B \ni CONTAINS AS MEMBER
= such that
- 220C $\not\ni$ DOES NOT CONTAIN AS MEMBER
≡ 220B \ni 0338 $\not\ni$
- 220D \ni SMALL CONTAINS AS MEMBER
→ 03F6 \ni greek reversed lunate epsilon symbol

Miscellaneous mathematical symbol

- 220E \blacksquare END OF PROOF
= q.e.d.
→ 2023 \blacktriangleright triangular bullet
→ 25AE \blacksquare black vertical rectangle

N-ary operators

- 220F \prod N-ARY PRODUCT
= product sign
→ 03A0 \prod greek capital letter pi
- 2210 \coprod N-ARY COPRODUCT
= coproduct sign
- 2211 \sum N-ARY SUMMATION
= summation sign
→ 03A3 \sum greek capital letter sigma
→ 2140 \sum double-struck n-ary summation

Operators

- 2212 $-$ MINUS SIGN
→ 002D $-$ hyphen-minus
→ 2796 — heavy minus sign
- 2213 \mp MINUS-OR-PLUS SIGN
→ 00B1 \pm plus-minus sign
- 2214 \dagger DOT PLUS
- 2215 $/$ DIVISION SLASH
• generic division operator
→ 002F $/$ solidus
→ 2044 $/$ fraction slash
→ 27CB $/$ mathematical rising diagonal
- 2216 \setminus SET MINUS
→ 005C \setminus reverse solidus
→ 27CD \setminus mathematical falling diagonal
→ 29F5 \setminus reverse solidus operator
- 2217 $*$ ASTERISK OPERATOR
→ 002A $*$ asterisk
- 2218 \circ RING OPERATOR
= composite function
= APL jot
→ 00B0 $^\circ$ degree sign
→ 0970 $^\circ$ devanagari abbreviation sign
→ 25E6 \circ white bullet
→ 10B39 $^\circ$ avestan abbreviation mark
- 2219 \bullet BULLET OPERATOR
→ 00B7 \cdot middle dot
→ 2022 \bullet bullet
→ 2024 \cdot one dot leader
- 221A \surd SQUARE ROOT
= radical sign
→ 2713 \surd check mark
- 221B $\sqrt[3]{}$ CUBE ROOT
→ 0606 $\sqrt[3]{}$ arabic-indic cube root
- 221C $\sqrt[4]{}$ FOURTH ROOT
→ 0607 $\sqrt[4]{}$ arabic-indic fourth root
- 221D \propto PROPORTIONAL TO
→ 03B1 α greek small letter alpha

Miscellaneous mathematical symbol

- 221E ∞ INFINITY

Angles

Other angle symbols are found at 299B-29AF.

- 221F \perp RIGHT ANGLE
= with (in chess notation)
→ 2BFE \perp reversed right angle
- 2220 \sphericalangle ANGLE
• used in astrological contexts for aspect semisquare
→ 299F \sphericalangle acute angle
- 2221 \sphericalangle MEASURED ANGLE
- 2222 \sphericalangle SPHERICAL ANGLE
= angle arc

Relations

- 2223 $|$ DIVIDES
= such that
= APL stile
→ 007C $|$ vertical line
→ 01C0 $|$ latin letter dental click
- 2224 \nmid DOES NOT DIVIDE
≡ 2223 $|$ 0338 $\not\mid$

- 2225 || PARALLEL TO
 → 01C1 || latin letter lateral click
 → 2016 || double vertical line
- 2226 ‖ NOT PARALLEL TO
 ≡ 2225 || 0338 ⧸

Logical and set operators

- 2227 ^ LOGICAL AND
 = wedge, conjunction
 → 22C0 ^ n-ary logical and
 → 2303 ^ up arrowhead
 → 27D1 ^ and with dot
- 2228 v LOGICAL OR
 = vee, disjunction
 → 22C1 v n-ary logical or
 → 2304 v down arrowhead
 → 27C7 v or with dot inside
- 2229 ∩ INTERSECTION
 = cap, hat
 → 22C2 ∩ n-ary intersection
 ~ 2229 FE00 ∩ with serifs
- 222A ∪ UNION
 = cup
 → 22C3 ∪ n-ary union
 ~ 222A FE00 ∪ with serifs

Integrals

- 222B ∫ INTEGRAL
 → 0283 ∫ latin small letter esh
- 222C ∬ DOUBLE INTEGRAL
 ≈ 222B ∫ 222B ∫
- 222D ∭ TRIPLE INTEGRAL
 → 2A0C ∭ quadruple integral operator
 ≈ 222B ∫ 222B ∫ 222B ∫
- 222E ∮ CONTOUR INTEGRAL
 → 2A15 ∮ integral around a point operator
- 222F ∯ SURFACE INTEGRAL
 ≈ 222E ∮ 222E ∮
- 2230 ∭ VOLUME INTEGRAL
 ≈ 222E ∮ 222E ∮ 222E ∮
- 2231 ∫ CLOCKWISE INTEGRAL
- 2232 ∮ CLOCKWISE CONTOUR INTEGRAL
- 2233 ∮ ANTICLOCKWISE CONTOUR INTEGRAL
 • clockwise or anticlockwise arrows do not reverse during layout mirroring

Miscellaneous mathematical symbols

- 2234 ∴ THEREFORE
 → 26EC ∴ historic site
- 2235 ∵ BECAUSE

Relations

- 2236 ∶ RATIO
 • preferred to 003A ∶ for denotation of division or scale in mathematical use
 → 003A ∶ colon
- 2237 ∷ PROPORTION

Operator

- 2238 ∸ DOT MINUS
 = saturating subtraction
 • sometimes claimed as notation for symmetric set difference, but 2206 Δ is preferred

Relation

- 2239 ∹ EXCESS

Operator

- 223A ∷ GEOMETRIC PROPORTION

Relations

- 223B ∼ HOMOTHETIC
 → 2A6B ∼ tilde operator with rising dots
- 223C ∼ TILDE OPERATOR
 = varies with (proportional to)
 = difference between
 = similar to
 = not
 = cycle
 = APL tilde
 → 007E ∼ tilde
 → 00AC ∼ not sign
 → 02DC ∼ small tilde
- 223D ∷ REVERSED TILDE
 = lazy S
 • reversed tilde and lazy S are glyph variants
- 223E ∷ INVERTED LAZY S
 = most positive

Miscellaneous mathematical symbol

- 223F ∼ SINE WAVE
 = alternating current

Operator

- 2240 ∸ WREATH PRODUCT

Relations

- 2241 ∼ NOT TILDE
 ≡ 223C ∼ 0338 ⧸
- 2242 ∼ MINUS TILDE
- 2243 ≈ ASYMPTOTICALLY EQUAL TO
- 2244 ≠ NOT ASYMPTOTICALLY EQUAL TO
 ≡ 2243 ≈ 0338 ⧸
- 2245 ≅ APPROXIMATELY EQUAL TO
 → 2A70 ≅ approximately equal or equal to
- 2246 ≉ APPROXIMATELY BUT NOT ACTUALLY EQUAL TO
- 2247 ≠ NEITHER APPROXIMATELY NOR ACTUALLY EQUAL TO
 ≡ 2245 ≅ 0338 ⧸
- 2248 ≈ ALMOST EQUAL TO
 = asymptotic to
- 2249 ≠ NOT ALMOST EQUAL TO
 ≡ 2248 ≈ 0338 ⧸
- 224A ≅ ALMOST EQUAL OR EQUAL TO
- 224B ≅ TRIPLE TILDE
- 224C ≡ ALL EQUAL TO
 • reversed tilde and lazy S are glyph variants
- 224D × EQUIVALENT TO
- 224E ≅ GEOMETRICALLY EQUIVALENT TO
- 224F ≅ DIFFERENCE BETWEEN
- 2250 ≅ APPROACHES THE LIMIT
- 2251 ≅ GEOMETRICALLY EQUAL TO
- 2252 ≅ APPROXIMATELY EQUAL TO OR THE IMAGE OF
 = nearly equals
- 2253 ≅ IMAGE OF OR APPROXIMATELY EQUAL TO
- 2254 ≅ COLON EQUALS
- 2255 ≅ EQUALS COLON
- 2256 ≅ RING IN EQUAL TO
- 2257 ≅ RING EQUAL TO
 = approximately equal to
- 2258 ≅ CORRESPONDS TO

2259	$\hat{=}$	ESTIMATES = corresponds to
225A	$\hat{=}$	EQUIANGULAR TO
225B	$\hat{=}$	STAR EQUALS
225C	$\hat{=}$	DELTA EQUAL TO = equiangular = equal to by definition
225D	$\hat{=}$	EQUAL TO BY DEFINITION
225E	$\hat{=}$	MEASURED BY
225F	$\hat{=}$	QUESTIONED EQUAL TO
2260	\neq	NOT EQUAL TO → 003D = equals sign → 01C2 † latin letter alveolar click ≡ 003D = 0338 \neq
2261	\equiv	IDENTICAL TO
2262	$\not\equiv$	NOT IDENTICAL TO ≡ 2261 ≡ 0338 \neq
2263	\equiv	STRICTLY EQUIVALENT TO
2264	\leq	LESS-THAN OR EQUAL TO → 003C < less-than sign
2265	\geq	GREATER-THAN OR EQUAL TO → 003E > greater-than sign
2266	\leq	LESS-THAN OVER EQUAL TO
2267	\geq	GREATER-THAN OVER EQUAL TO
2268	$\not\leq$	LESS-THAN BUT NOT EQUAL TO → 2A87 \leq less-than and single-line not equal to ~ 2268 FE00 \leq with vertical stroke
2269	$\not\geq$	GREATER-THAN BUT NOT EQUAL TO → 2A88 \geq greater-than and single-line not equal to ~ 2269 FE00 \geq with vertical stroke
226A	\ll	MUCH LESS-THAN → 00AB \ll left-pointing double angle quotation mark
226B	\gg	MUCH GREATER-THAN → 00BB \gg right-pointing double angle quotation mark
226C	between	BETWEEN = plaintiff, quantic
226D	$\not\approx$	NOT EQUIVALENT TO ≡ 224D \approx 0338 \neq
226E	$\not\lessgtr$	NOT LESS-THAN ≡ 003C < 0338 \neq
226F	$\not\gtrless$	NOT GREATER-THAN ≡ 003E > 0338 \neq
2270	$\not\leq$	NEITHER LESS-THAN NOR EQUAL TO ≡ 2264 \leq 0338 \neq
2271	$\not\geq$	NEITHER GREATER-THAN NOR EQUAL TO ≡ 2265 \geq 0338 \neq
2272	\leq	LESS-THAN OR EQUIVALENT TO ~ 2272 FE00 \leq following the slant of the lower leg
2273	\geq	GREATER-THAN OR EQUIVALENT TO ~ 2273 FE00 \geq following the slant of the lower leg
2274	$\not\leq$	NEITHER LESS-THAN NOR EQUIVALENT TO ≡ 2272 \leq 0338 \neq
2275	$\not\geq$	NEITHER GREATER-THAN NOR EQUIVALENT TO ≡ 2273 \geq 0338 \neq
2276	\leq	LESS-THAN OR GREATER-THAN
2277	\geq	GREATER-THAN OR LESS-THAN
2278	$\not\leq$	NEITHER LESS-THAN NOR GREATER-THAN ≡ 2276 \leq 0338 \neq

2279	$\not\leq$	NEITHER GREATER-THAN NOR LESS-THAN ≡ 2277 \geq 0338 \neq
227A	\prec	PRECEDES = lower rank than → 22B0 \prec precedes under relation
227B	\succ	SUCCEEDS = higher rank than → 22B1 \succ succeeds under relation
227C	\leq	PRECEDES OR EQUAL TO
227D	\geq	SUCCEEDS OR EQUAL TO
227E	\leq	PRECEDES OR EQUIVALENT TO
227F	\geq	SUCCEEDS OR EQUIVALENT TO
2280	$\not\prec$	DOES NOT PRECEDE ≡ 227A < 0338 \neq
2281	$\not\succ$	DOES NOT SUCCEED ≡ 227B > 0338 \neq
2282	\subset	SUBSET OF = included in set → 2E26 \subset left sideways u bracket
2283	\supset	SUPERSET OF = includes in set → 2E27 \supset right sideways u bracket
2284	$\not\subset$	NOT A SUBSET OF ≡ 2282 \subset 0338 \neq
2285	$\not\supset$	NOT A SUPERSET OF ≡ 2283 \supset 0338 \neq
2286	\subseteq	SUBSET OF OR EQUAL TO
2287	\supseteq	SUPERSET OF OR EQUAL TO
2288	$\not\subseteq$	NEITHER A SUBSET OF NOR EQUAL TO ≡ 2286 \subseteq 0338 \neq
2289	$\not\supseteq$	NEITHER A SUPERSET OF NOR EQUAL TO ≡ 2287 \supseteq 0338 \neq
228A	\subsetneq	SUBSET OF WITH NOT EQUAL TO ~ 228A FE00 \subsetneq with stroke through bottom members
228B	\supsetneq	SUPERSET OF WITH NOT EQUAL TO ~ 228B FE00 \supsetneq with stroke through bottom members

Operators

228C	\cup	MULTISET
228D	\cup	MULTISET MULTIPLICATION → 2A03 \cup n-ary union operator with dot → 2A40 \cup intersection with dot
228E	\cup	MULTISET UNION = z notation bag addition → 2A04 \cup n-ary union operator with plus

Relations

228F	\square	SQUARE IMAGE OF
2290	\square	SQUARE ORIGINAL OF
2291	\square	SQUARE IMAGE OF OR EQUAL TO
2292	\square	SQUARE ORIGINAL OF OR EQUAL TO

Operators

2293	\sqcap	SQUARE CAP → 2A05 \sqcap n-ary square intersection operator ~ 2293 FE00 \sqcap with serifs
2294	\sqcup	SQUARE CUP → 2A06 \sqcup n-ary square union operator ~ 2294 FE00 \sqcup with serifs

- 2295 \oplus **CIRCLED PLUS**
= direct sum
= vector pointing into page
→ 2A01 \oplus n-ary circled plus operator
→ 1F728 \oplus alchemical symbol for verdigris
~ 2295 FE00 \oplus with white rim
- 2296 \ominus **CIRCLED MINUS**
= symmetric difference
→ 29B5 \ominus circle with horizontal bar
→ 1F714 \ominus alchemical symbol for salt
- 2297 \otimes **CIRCLED TIMES**
= tensor product
= vector pointing into page
→ 26D2 \otimes circled crossing lanes
→ 2A02 \otimes n-ary circled times operator
→ 2BBE \otimes circled x
→ 1F774 \otimes lot of fortune
~ 2297 FE00 \otimes with white rim
- 2298 \oslash **CIRCLED DIVISION SLASH**
- 2299 \odot **CIRCLED DOT OPERATOR**
= direct product
= vector pointing out of page
→ 0298 \odot latin letter bilabial click
→ 2609 \odot sun
→ 2A00 \odot n-ary circled dot operator
- 229A \odot **CIRCLED RING OPERATOR**
→ 233E \odot apl functional symbol circle jot
→ 25CE \odot bullseye
- 229B \otimes **CIRCLED ASTERISK OPERATOR**
→ 235F \otimes apl functional symbol circle star
- 229C \equiv **CIRCLED EQUALS**
= NoDerivatives (symbol used for Creative Commons licenses)
→ 1F16D \equiv circled cc
~ 229C FE00 \equiv with equal sign touching the circle
- 229D \ominus **CIRCLED DASH**
- 229E \boxplus **SQUARED PLUS**
- 229F \boxminus **SQUARED MINUS**
- 22A0 \boxtimes **SQUARED TIMES**
→ 2612 \boxtimes ballot box with x
→ 26DD \boxtimes squared saltire
→ 1F771 \boxtimes alchemical symbol for month
- 22A1 \boxdot **SQUARED DOT OPERATOR**
→ 1F755 \boxdot alchemical symbol for urine
→ 1FBBC \boxdot right open squared dot
- 22A2 \vdash **RIGHT TACK**
= turnstile
= proves, implies, yields
= reducible
- 22A3 \dashv **LEFT TACK**
= reverse turnstile
= non-theorem, does not yield

Miscellaneous mathematical symbols

- 22A4 \top **DOWN TACK**
= top
→ 2E06 \top raised interpolation marker
→ 1F768 \top alchemical symbol for crucible-4
- 22A5 \perp **UP TACK**
= base, bottom
→ 27C2 \perp perpendicular

Relations

- 22A6 \vdash **ASSERTION**
= reduces to
- 22A7 \models **MODELS**
- 22A8 \vDash **TRUE**
= statement is true, valid
= is a tautology
= satisfies
= results in
- 22A9 \Vdash **FORCES**
- 22AA \equiv **TRIPLE VERTICAL BAR RIGHT TURNSTILE**
- 22AB \Vdash **DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE**
- 22AC \nVdash **DOES NOT PROVE**
 \equiv 22A2 \vdash 0338 $\not\vdash$
- 22AD $\n\vDash$ **NOT TRUE**
 \equiv 22A8 \vDash 0338 $\not\vDash$
- 22AE \nVdash **DOES NOT FORCE**
 \equiv 22A9 \Vdash 0338 $\not\Vdash$
- 22AF \nVdash **NEGATED DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE**
 \equiv 22AB \Vdash 0338 $\not\vDash$
- 22B0 \preceq **PRECEDES UNDER RELATION**
→ 227A \prec precedes
- 22B1 \succeq **SUCCEEDS UNDER RELATION**
→ 227B \succ succeeds
- 22B2 \triangleleft **NORMAL SUBGROUP OF**
→ 25C5 \triangleleft white left-pointing pointer
- 22B3 \triangleright **CONTAINS AS NORMAL SUBGROUP**
→ 25BB \triangleright white right-pointing pointer
- 22B4 \trianglelefteq **NORMAL SUBGROUP OF OR EQUAL TO**
- 22B5 \trianglerighteq **CONTAINS AS NORMAL SUBGROUP OR EQUAL TO**
- 22B6 $\xrightarrow{\circ}$ **ORIGINAL OF**
- 22B7 $\xleftarrow{\circ}$ **IMAGE OF**
- 22B8 \multimap **MULTIMAP**
- 22B9 \dagger **HERMITIAN CONJUGATE MATRIX**

Operators

- 22BA \Uparrow **INTERCALATE**
- 22BB \Downarrow **XOR**
→ 26BA \Downarrow semisextile
- 22BC $\bar{\wedge}$ **NAND**
→ 2305 $\bar{\wedge}$ projective
→ 26BB $\bar{\wedge}$ quincunx
- 22BD ∇ **NOR**

Miscellaneous mathematical symbols

- 22BE \sphericalangle **RIGHT ANGLE WITH ARC**
- 22BF \triangle **RIGHT TRIANGLE**

N-ary operators

- 22C0 \bigwedge **N-ARY LOGICAL AND**
• also used to denote the universal quantifier
→ 2227 \bigwedge logical and
- 22C1 \bigvee **N-ARY LOGICAL OR**
• also used to denote the existential quantifier
→ 2228 \bigvee logical or
- 22C2 \bigcap **N-ARY INTERSECTION**
= z notation generalised intersection
→ 2229 \bigcap intersection
- 22C3 \bigcup **N-ARY UNION**
= z notation generalised union
→ 222A \bigcup union

Operators

- 22C4 ◊ DIAMOND OPERATOR
→ 25C7 ◊ white diamond
→ 2B29 ◆ black small diamond
- 22C5 · DOT OPERATOR
• preferred to 00B7 · for denotation of multiplication
→ 00B7 · middle dot
- 22C6 ★ STAR OPERATOR
• APL
→ 066D ★ arabic five pointed star
→ 2605 ★ black star
→ 2B50 ☆ white medium star
- 22C7 ✖ DIVISION TIMES
→ 00D7 ✖ multiplication sign
→ 00F7 ÷ division sign
→ 2715 ✕ multiplication x

Relation

- 22C8 ⚭ BOWTIE
→ 2445 ⚭ ocr bow tie

Operators

- 22C9 ⋈ LEFT NORMAL FACTOR SEMIDIRECT PRODUCT
- 22CA ⋉ RIGHT NORMAL FACTOR SEMIDIRECT PRODUCT
- 22CB ⋊ LEFT SEMIDIRECT PRODUCT
- 22CC ⋋ RIGHT SEMIDIRECT PRODUCT
→ 2041 ⋋ caret insertion point

Relation

- 22CD ≍ REVERSED TILDE EQUALS

Logical operators

- 22CE ∨ CURLY LOGICAL OR
- 22CF ∧ CURLY LOGICAL AND

Relations

- 22D0 ⊆ DOUBLE SUBSET
- 22D1 ⊇ DOUBLE SUPerset

Operators

- 22D2 ∩ DOUBLE INTERSECTION
- 22D3 ∪ DOUBLE UNION

Relations

- 22D4 ∩ PITCHFORK
= proper intersection
- 22D5 # EQUAL AND PARALLEL TO
→ 2317 # viewdata square
- 22D6 < LESS-THAN WITH DOT
- 22D7 > GREATER-THAN WITH DOT
- 22D8 ≪ VERY MUCH LESS-THAN
- 22D9 ≫ VERY MUCH GREATER-THAN
- 22DA ≍ LESS-THAN EQUAL TO OR GREATER-THAN
~ 22DA FE00 ≍ with slanted equal
- 22DB ≎ GREATER-THAN EQUAL TO OR LESS-THAN
~ 22DB FE00 ≎ with slanted equal
- 22DC ≐ EQUAL TO OR LESS-THAN
- 22DD ≑ EQUAL TO OR GREATER-THAN
- 22DE ≒ EQUAL TO OR PRECEDES
- 22DF ≓ EQUAL TO OR SUCCEEDS
- 22E0 ⋈ DOES NOT PRECEDE OR EQUAL
≍ 227C ≍ 0338 ⋈
- 22E1 ⋉ DOES NOT SUCCEED OR EQUAL
≍ 227D ≍ 0338 ⋉

- 22E2 ⋊ NOT SQUARE IMAGE OF OR EQUAL TO
≍ 2291 ⋊ 0338 ⋊
- 22E3 ⋋ NOT SQUARE ORIGINAL OF OR EQUAL TO
≍ 2292 ⋋ 0338 ⋋
- 22E4 ⋌ SQUARE IMAGE OF OR NOT EQUAL TO
- 22E5 ⋍ SQUARE ORIGINAL OF OR NOT EQUAL TO
- 22E6 ⋎ LESS-THAN BUT NOT EQUIVALENT TO
- 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 ⋒
- 22EB ⋓ DOES NOT CONTAIN AS NORMAL SUBGROUP
≍ 22B3 ⋓ 0338 ⋓
- 22EC ⋔ NOT NORMAL SUBGROUP OF OR EQUAL TO
≍ 22B4 ⋔ 0338 ⋔
- 22ED ⋕ DOES NOT CONTAIN AS NORMAL SUBGROUP OR EQUAL
≍ 22B5 ⋕ 0338 ⋕

































Matrix ellipses

These four ellipsis characters are used for matrix row/column elision.

- 22EE ∷ VERTICAL ELLIPSIS
→ 205D ∷ tricolon
→ 2026 ... horizontal ellipsis
→ FE19 ∷ presentation form for vertical horizontal ellipsis
- 22EF ∸ MIDLINE HORIZONTAL ELLIPSIS
- 22F0 ∶ UP RIGHT DIAGONAL ELLIPSIS
- 22F1 ∷ DOWN RIGHT DIAGONAL ELLIPSIS

Relations

- 22F2 ∈ ELEMENT OF WITH LONG HORIZONTAL STROKE
- 22F3 ∋ ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22F4 ∉ SMALL ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22F5 ∷ ELEMENT OF WITH DOT ABOVE
- 22F6 ∷ ELEMENT OF WITH OVERBAR
- 22F7 ∷ SMALL ELEMENT OF WITH OVERBAR
- 22F8 ∷ ELEMENT OF WITH UNDERBAR
- 22F9 ∷ ELEMENT OF WITH TWO HORIZONTAL STROKES
- 22FA ⊃ CONTAINS WITH LONG HORIZONTAL STROKE
- 22FB ⊃ CONTAINS WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22FC ⊂ SMALL CONTAINS WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22FD ⊃ CONTAINS WITH OVERBAR
- 22FE ⊂ SMALL CONTAINS WITH OVERBAR
- 22FF ∈ Z NOTATION BAG MEMBERSHIP

Standardized Variation Sequences	
2205	 EMPTY SET <small>2205</small>  zero with long diagonal stroke overlay form <small>2205 FE00</small>
2229	 INTERSECTION <small>2229</small>  with serifs <small>2229 FE00</small>
222A	 UNION <small>222A</small>  with serifs <small>222A FE00</small>
2268	 LESS-THAN BUT NOT EQUAL TO <small>2268</small>  with vertical stroke <small>2268 FE00</small>
2269	 GREATER-THAN BUT NOT EQUAL TO <small>2269</small>  with vertical stroke <small>2269 FE00</small>
2272	 LESS-THAN OR EQUIVALENT TO <small>2272</small>  following the slant of the lower leg <small>2272 FE00</small>
2273	 GREATER-THAN OR EQUIVALENT TO <small>2273</small>  following the slant of the lower leg <small>2273 FE00</small>
228A	 SUBSET OF WITH NOT EQUAL TO <small>228A</small>  with stroke through bottom members <small>228A FE00</small>
228B	 SUPERSET OF WITH NOT EQUAL TO <small>228B</small>  with stroke through bottom members <small>228B FE00</small>
2293	 SQUARE CAP <small>2293</small>  with serifs <small>2293 FE00</small>
2294	 SQUARE CUP <small>2294</small>  with serifs <small>2294 FE00</small>
2295	 CIRCLED PLUS <small>2295</small>  with white rim <small>2295 FE00</small>
2297	 CIRCLED TIMES <small>2297</small>  with white rim <small>2297 FE00</small>
229C	 CIRCLED EQUALS <small>229C</small>  with equal sign touching the circle <small>229C FE00</small>
22DA	 LESS-THAN EQUAL TO OR GREATER-THAN <small>22DA</small>  with slanted equal <small>22DA FE00</small>
22DB	 GREATER-THAN EQUAL TO OR LESS-THAN <small>22DB</small>  with slanted equal <small>22DB FE00</small>