

## Mathematical Operators

**Range: 2200–22FF**

This chart contains an excerpt from the character code tables and list of character names for *The Unicode Standard, Version 18.0*

This file will not be updated with errata, or when additional characters are assigned to the Unicode Standard.

See <https://www.unicode.org/errata/> for an up-to-date list of errata.

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-18.0/> for charts showing only the characters added in Unicode 18.0. See <https://www.unicode.org/Public/18.0.0/charts/> for a complete set of character code charts for Unicode 18.0. See <https://www.unicode.org/Public/18.0.0/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 18.0 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 18.0, online at:

<https://www.unicode.org/versions/Unicode18.0.0/>

### Fonts

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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 | <br>2200   | <br>2210   | <br>2220   | <br>2230   | <br>2240   | <br>2250   | <br>2260   | <br>2270   | <br>2280   | <br>2290   | <br>22A0   | <br>22B0   | <br>22C0   | <br>22D0   | <br>22E0   | <br>22F0   |
| 1 | <br>2201   | <br>2211   | <br>2221   | <br>2231   | <br>2241   | <br>2251   | <br>2261   | <br>2271   | <br>2281   | <br>2291   | <br>22A1   | <br>22B1   | <br>22C1   | <br>22D1   | <br>22E1   | <br>22F1   |
| 2 | <br>2202   | <br>2212   | <br>2222   | <br>2232   | <br>2242   | <br>2252   | <br>2262   | <br>2272   | <br>2282   | <br>2292   | <br>22A2   | <br>22B2   | <br>22C2   | <br>22D2   | <br>22E2   | <br>22F2   |
| 3 | <br>2203   | <br>2213   | <br>2223   | <br>2233   | <br>2243   | <br>2253   | <br>2263   | <br>2273   | <br>2283   | <br>2293   | <br>22A3   | <br>22B3   | <br>22C3   | <br>22D3   | <br>22E3   | <br>22F3   |
| 4 | <br>2204   | <br>2214   | <br>2224   | <br>2234   | <br>2244   | <br>2254   | <br>2264   | <br>2274   | <br>2284   | <br>2294   | <br>22A4   | <br>22B4   | <br>22C4   | <br>22D4   | <br>22E4   | <br>22F4   |
| 5 | <br>2205   | <br>2215   | <br>2225   | <br>2235   | <br>2245   | <br>2255   | <br>2265   | <br>2275   | <br>2285   | <br>2295   | <br>22A5   | <br>22B5   | <br>22C5   | <br>22D5   | <br>22E5   | <br>22F5   |
| 6 | <br>2206   | <br>2216   | <br>2226   | <br>2236   | <br>2246   | <br>2256   | <br>2266   | <br>2276   | <br>2286   | <br>2296   | <br>22A6   | <br>22B6   | <br>22C6   | <br>22D6   | <br>22E6   | <br>22F6   |
| 7 | <br>2207 | <br>2217 | <br>2227 | <br>2237 | <br>2247 | <br>2257 | <br>2267 | <br>2277 | <br>2287 | <br>2297 | <br>22A7 | <br>22B7 | <br>22C7 | <br>22D7 | <br>22E7 | <br>22F7 |
| 8 | <br>2208 | <br>2218 | <br>2228 | <br>2238 | <br>2248 | <br>2258 | <br>2268 | <br>2278 | <br>2288 | <br>2298 | <br>22A8 | <br>22B8 | <br>22C8 | <br>22D8 | <br>22E8 | <br>22F8 |
| 9 | <br>2209 | <br>2219 | <br>2229 | <br>2239 | <br>2249 | <br>2259 | <br>2269 | <br>2279 | <br>2289 | <br>2299 | <br>22A9 | <br>22B9 | <br>22C9 | <br>22D9 | <br>22E9 | <br>22F9 |
| A | <br>220A | <br>221A | <br>222A | <br>223A | <br>224A | <br>225A | <br>226A | <br>227A | <br>228A | <br>229A | <br>22AA | <br>22BA | <br>22CA | <br>22DA | <br>22EA | <br>22FA |
| B | <br>220B | <br>221B | <br>222B | <br>223B | <br>224B | <br>225B | <br>226B | <br>227B | <br>228B | <br>229B | <br>22AB | <br>22BB | <br>22CB | <br>22DB | <br>22EB | <br>22FB |
| C | <br>220C | <br>221C | <br>222C | <br>223C | <br>224C | <br>225C | <br>226C | <br>227C | <br>228C | <br>229C | <br>22AC | <br>22BC | <br>22CC | <br>22DC | <br>22EC | <br>22FC |
| D | <br>220D | <br>221D | <br>222D | <br>223D | <br>224D | <br>225D | <br>226D | <br>227D | <br>228D | <br>229D | <br>22AD | <br>22BD | <br>22CD | <br>22DD | <br>22ED | <br>22FD |
| E | <br>220E | <br>221E | <br>222E | <br>223E | <br>224E | <br>225E | <br>226E | <br>227E | <br>228E | <br>229E | <br>22AE | <br>22BE | <br>22CE | <br>22DE | <br>22EE | <br>22FE |
| F | <br>220F | <br>221F | <br>222F | <br>223F | <br>224F | <br>225F | <br>226F | <br>227F | <br>228F | <br>229F | <br>22AF | <br>22BF | <br>22CF | <br>22DF | <br>22EF | <br>22FF |

**Miscellaneous mathematical symbols**

- 2200  $\forall$  **FOR ALL**  
= universal quantifier
- 2201  $\complement$  **COMPLEMENT**  
→ 0297  $\complement$  latin letter stretched c
- 2202  $\partial$  **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  $\varnothing$  diameter sign  
~ 2205 FE00  $\varnothing$  zero with long diagonal stroke overlay form
- 2206  $\Delta$  **INCREMENT**  
= Laplace operator  
= forward difference  
= symmetric difference (in set theory)  
• other symbols may also be used for symmetric difference  
→ 0394  $\Delta$  greek capital letter delta  
→ 25B3  $\triangle$  white up-pointing triangle
- 2207  $\nabla$  **NABLA**  
= backward difference  
= gradient, del  
• used for Laplacian operator (written with superscript 2)  
→ 25BD  $\nabla$  white down-pointing triangle

**Set membership**

- 2208  $\in$  **ELEMENT OF**
- 2209  $\notin$  **NOT AN ELEMENT OF**  
≡ 2208  $\in$  0338  $\not\in$
- 220A  $\epsilon$  **SMALL ELEMENT OF**  
• originates in math pi fonts; not the straight epsilon  
→ 03F5  $\epsilon$  greek lunate epsilon symbol
- 220B  $\ni$  **CONTAINS AS MEMBER**  
= such that
- 220C  $\nni$  **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  $\Sigma$  greek capital letter sigma  
→ 2140  $\sum\limits$  double-struck n-ary summation

**Operators**

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

**Miscellaneous mathematical symbol**

- 221E  $\infty$  **INFINITY**

**Angles**

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

- 221F  $\perp$  **RIGHT ANGLE**  
= with (in chess notation)  
→ 2BFE  $\perp$  reversed right angle
- 2220  $\angle$  **ANGLE**  
• used in astrological contexts for aspect semisquare  
→ 299F  $\angle$  acute angle
- 2221  $\sphericalangle$  **MEASURED ANGLE**  
→ 1CEF9  $\sphericalangle$  measured angle with double arc
- 2222  $\frown$  **SPHERICAL ANGLE**  
= angle arc

**Relations**

- 2223  $|$  **DIVIDES**  
= such that  
= APL stile  
→ 007C  $|$  vertical line  
→ 01C0  $|$  latin letter dental click

- 2224 † DOES NOT DIVIDE  
 $\equiv$  2223 | 0338  $\nmid$
- 2225 ‖ PARALLEL TO  
 $\rightarrow$  01C1 ‖ latin letter lateral click  
 $\rightarrow$  2016 ‖ double vertical line
- 2226   NOT PARALLEL TO  
 $\equiv$  2225 ‖ 0338  $\nparallel$

**Logical and set operators**

- 2227  $\wedge$  LOGICAL AND  
 $=$  wedge, conjunction  
 $\rightarrow$  22C0  $\bigwedge$  n-ary logical and  
 $\rightarrow$  2303  $\Uparrow$  up arrowhead  
 $\rightarrow$  27D1  $\mathrel{\wedge}$  and with dot
- 2228  $\vee$  LOGICAL OR  
 $=$  vee, disjunction  
 $\rightarrow$  22C1  $\bigvee$  n-ary logical or  
 $\rightarrow$  2304  $\Downarrow$  down arrowhead  
 $\rightarrow$  27C7  $\vee$  or with dot inside
- 2229  $\cap$  INTERSECTION  
 $=$  cap, hat  
 $\rightarrow$  22C2  $\bigcap$  n-ary intersection  
 $\sim$  2229 FE00  $\cap$  with serifs
- 222A  $\cup$  UNION  
 $=$  cup  
 $\rightarrow$  22C3  $\bigcup$  n-ary union  
 $\sim$  222A FE00  $\cup$  with serifs

**Integrals**

- 222B  $\int$  INTEGRAL  
 $\rightarrow$  0283  $\mathfrak{f}$  latin small letter esh
- 222C  $\iint$  DOUBLE INTEGRAL  
 $\approx$  222B  $\int$  222B  $\int$
- 222D  $\iiint$  TRIPLE INTEGRAL  
 $\rightarrow$  2A0C  $\iiint$  quadruple integral operator  
 $\approx$  222B  $\int$  222B  $\int$  222B  $\int$
- 222E  $\oint$  CONTOUR INTEGRAL  
 $\rightarrow$  2A15  $\oint$  integral around a point operator
- 222F  $\oiint$  SURFACE INTEGRAL  
 $\approx$  222E  $\oint$  222E  $\oint$
- 2230  $\iiint$  VOLUME INTEGRAL  
 $\approx$  222E  $\oint$  222E  $\oint$  222E  $\oint$
- 2231  $\int\limits_{\circlearrowright}$  CLOCKWISE INTEGRAL
- 2232  $\oint\limits_{\circlearrowright}$  CLOCKWISE CONTOUR INTEGRAL
- 2233  $\oint\limits_{\circlearrowleft}$  ANTICLOCKWISE CONTOUR INTEGRAL  
 $\bullet$  clockwise or anticlockwise arrows do not reverse during layout mirroring

**Miscellaneous mathematical symbols**

- 2234  $\therefore$  THEREFORE  
 $\rightarrow$  26EC  $\therefore$  historic site
- 2235  $\because$  BECAUSE

**Relations**

- 2236  $:$  RATIO  
 $\bullet$  preferred to 003A  $:$  for denotation of division or scale in mathematical use  
 $\rightarrow$  003A  $:$  colon
- 2237  $::$  PROPORTION

**Operator**

- 2238  $\dot{-}$  DOT MINUS  
 $=$  saturating subtraction  
 $\bullet$  sometimes claimed as notation for symmetric set difference, but 2206  $\Delta$  is preferred

**Relation**

- 2239  $\therefore$  EXCESS

**Operator**

- 223A  $\doteq$  GEOMETRIC PROPORTION

**Relations**

- 223B  $\simeq$  HOMOTHETIC  
 $\rightarrow$  2A6B  $\simeq$  tilde operator with rising dots
- 223C  $\sim$  TILDE OPERATOR  
 $=$  varies with (proportional to)  
 $=$  difference between  
 $=$  similar to  
 $=$  not  
 $=$  cycle  
 $=$  APL tilde  
 $\rightarrow$  007E  $\sim$  tilde  
 $\rightarrow$  00AC  $\neg$  not sign  
 $\rightarrow$  02DC  $\tilde$  small tilde
- 223D  $\smile$  REVERSED TILDE  
 $=$  lazy S  
 $\bullet$  reversed tilde and lazy S are glyph variants  
 $\sim$  223D FE00  $\smile$  using lazy S
- 223E  $\approx$  INVERTED LAZY S  
 $=$  most positive

**Miscellaneous mathematical symbol**

- 223F  $\sim$  SINE WAVE  
 $=$  alternating current  
 $\rightarrow$  23E6  $\approx$  ac current

**Operator**

- 2240  $\text{z}$  WREATH PRODUCT  
 $\rightarrow$  2E2F  $\text{z}$  vertical tilde

**Relations**

- 2241  $\napprox$  NOT TILDE  
 $\equiv$  223C  $\sim$  0338  $\nmid$
- 2242  $\napprox$  MINUS TILDE  
 $\sim$  2242 FE00  $\napprox$  using lazy S
- 2243  $\approx$  ASYMPTOTICALLY EQUAL TO  
 $\sim$  2243 FE00  $\approx$  using lazy S
- 2244  $\napprox$  NOT ASYMPTOTICALLY EQUAL TO  
 $\equiv$  2243  $\approx$  0338  $\nmid$
- 2245  $\cong$  APPROXIMATELY EQUAL TO  
 $\rightarrow$  2A70  $\cong$  approximately equal or equal to
- 2246  $\ncong$  APPROXIMATELY BUT NOT ACTUALLY EQUAL TO
- 2247  $\ncong$  NEITHER APPROXIMATELY NOR ACTUALLY EQUAL TO  
 $\equiv$  2245  $\cong$  0338  $\nmid$
- 2248  $\approx$  ALMOST EQUAL TO  
 $=$  asymptotic to  
 $\sim$  2248 FE00  $\approx$  using lazy S
- 2249  $\napprox$  NOT ALMOST EQUAL TO  
 $\equiv$  2248  $\approx$  0338  $\nmid$
- 224A  $\approx$  ALMOST EQUAL OR EQUAL TO
- 224B  $\approx$  TRIPLE TILDE
- 224C  $\equiv$  ALL EQUAL TO  
 $\bullet$  reversed tilde and lazy S are glyph variants
- 224D  $\asymp$  EQUIVALENT TO
- 224E  $\asymp$  GEOMETRICALLY EQUIVALENT TO
- 224F  $\pm$  DIFFERENCE BETWEEN
- 2250  $\doteq$  APPROACHES THE LIMIT
- 2251  $\doteq$  GEOMETRICALLY EQUAL TO

|      |   |                                                                                                                                 |                  |   |                                                                                                                 |
|------|---|---------------------------------------------------------------------------------------------------------------------------------|------------------|---|-----------------------------------------------------------------------------------------------------------------|
| 2252 | ≈ | APPROXIMATELY EQUAL TO OR THE IMAGE OF<br>= nearly equals                                                                       | 2273             | ⋈ | GREATER-THAN OR EQUIVALENT TO<br>~ 2273 FE00 ⋈ following the slant of the lower leg                             |
| 2253 | ≐ | IMAGE OF OR APPROXIMATELY EQUAL TO                                                                                              | 2274             | ⋈ | NEITHER LESS-THAN NOR EQUIVALENT TO<br>≡ 2272 ⋈ 0338 ∅                                                          |
| 2254 | ⋈ | COLON EQUALS                                                                                                                    | 2275             | ⋈ | NEITHER GREATER-THAN NOR EQUIVALENT TO<br>≡ 2273 ⋈ 0338 ∅                                                       |
| 2255 | ⋈ | EQUALS COLON                                                                                                                    | 2276             | ⋈ | LESS-THAN OR GREATER-THAN                                                                                       |
| 2256 | ⋈ | RING IN EQUAL TO                                                                                                                | 2277             | ⋈ | GREATER-THAN OR LESS-THAN                                                                                       |
| 2257 | ⋈ | RING EQUAL TO<br>= approximately equal to                                                                                       | 2278             | ⋈ | NEITHER LESS-THAN NOR GREATER-THAN<br>≡ 2276 ⋈ 0338 ∅                                                           |
| 2258 | ⋈ | CORRESPONDS TO                                                                                                                  | 2279             | ⋈ | NEITHER GREATER-THAN NOR LESS-THAN<br>≡ 2277 ⋈ 0338 ∅                                                           |
| 2259 | ⋈ | ESTIMATES<br>= corresponds to                                                                                                   | 227A             | < | PRECEDES<br>= lower rank than<br>→ 22B0 ⋈ precedes under relation                                               |
| 225A | ⋈ | EQUIANGULAR TO                                                                                                                  | 227B             | > | SUCCEEDS<br>= higher rank than<br>→ 22B1 ⋈ succeeds under relation                                              |
| 225B | ⋈ | STAR EQUALS                                                                                                                     | 227C             | ⋈ | PRECEDES OR EQUAL TO<br>→ 2A AF ⋈ precedes above single-line equals sign<br>→ 2AB3 ⋈ precedes above equals sign |
| 225C | ⋈ | DELTA EQUAL TO<br>= equiangular<br>= equal to by definition                                                                     | 227D             | ⋈ | SUCCEEDS OR EQUAL TO<br>→ 2AB0 ⋈ succeeds above single-line equals sign<br>→ 2AB4 ⋈ succeeds above equals sign  |
| 225D | ⋈ | EQUAL TO BY DEFINITION                                                                                                          | 227E             | ⋈ | PRECEDES OR EQUIVALENT TO<br>→ 2AB7 ⋈ precedes above almost equal to                                            |
| 225E | ⋈ | MEASURED BY                                                                                                                     | 227F             | ⋈ | SUCCEEDS OR EQUIVALENT TO<br>→ 2AB8 ⋈ succeeds above almost equal to                                            |
| 225F | ⋈ | QUESTIONED EQUAL TO                                                                                                             | 2280             | ⋈ | DOES NOT PRECEDE<br>≡ 227A < 0338 ∅                                                                             |
| 2260 | ≠ | NOT EQUAL TO<br>→ 003D = equals sign<br>→ 01C2 † latin letter alveolar click<br>≡ 003D = 0338 ∅                                 | 2281             | ⋈ | DOES NOT SUCCEED<br>≡ 227B > 0338 ∅                                                                             |
| 2261 | ≡ | IDENTICAL TO                                                                                                                    | 2282             | ⋈ | SUBSET OF<br>= included in set<br>→ 2E26 ⋈ left sideways u bracket                                              |
| 2262 | ≢ | NOT IDENTICAL TO<br>≡ 2261 ≡ 0338 ∅                                                                                             | 2283             | ⋈ | SUPERSET OF<br>= includes in set<br>→ 2E27 ⋈ right sideways u bracket                                           |
| 2263 | ≡ | STRICTLY EQUIVALENT TO                                                                                                          | 2284             | ⋈ | NOT A SUBSET OF<br>≡ 2282 ⋈ 0338 ∅                                                                              |
| 2264 | ≤ | LESS-THAN OR EQUAL TO<br>→ 003C < less-than sign<br>→ 29A4 ⋈ angle with underbar                                                | 2285             | ⋈ | NOT A SUPERSET OF<br>≡ 2283 ⋈ 0338 ∅                                                                            |
| 2265 | ≥ | GREATER-THAN OR EQUAL TO<br>→ 003E > greater-than sign<br>→ 29A5 ⋈ reversed angle with underbar                                 | 2286             | ⋈ | SUBSET OF OR EQUAL TO                                                                                           |
| 2266 | ⋈ | LESS-THAN OVER EQUAL TO                                                                                                         | 2287             | ⋈ | SUPERSET OF OR EQUAL TO                                                                                         |
| 2267 | ⋈ | GREATER-THAN OVER EQUAL TO                                                                                                      | 2288             | ⋈ | NEITHER A SUBSET OF NOR EQUAL TO<br>≡ 2286 ⋈ 0338 ∅                                                             |
| 2268 | ⋈ | LESS-THAN BUT NOT EQUAL TO<br>→ 2A87 ⋈ less-than and single-line not equal to<br>~ 2268 FE00 ⋈ with vertical stroke             | 2289             | ⋈ | NEITHER A SUPERSET OF NOR EQUAL TO<br>≡ 2287 ⋈ 0338 ∅                                                           |
| 2269 | ⋈ | GREATER-THAN BUT NOT EQUAL TO<br>→ 2A88 ⋈ greater-than and single-line not equal to<br>to<br>~ 2269 FE00 ⋈ with vertical stroke | 228A             | ⋈ | SUBSET OF WITH NOT EQUAL TO<br>~ 228A FE00 ⋈ with stroke through bottom members                                 |
| 226A | ⋈ | MUCH LESS-THAN<br>→ 00AB ⋈ left-pointing double angle quotation mark                                                            | 228B             | ⋈ | SUPERSET OF WITH NOT EQUAL TO<br>~ 228B FE00 ⋈ with stroke through bottom members                               |
| 226B | ⋈ | MUCH GREATER-THAN<br>→ 00BB ⋈ right-pointing double angle quotation mark                                                        | <b>Operators</b> |   |                                                                                                                 |
| 226C | ⋈ | BETWEEN<br>= plaintiff, quantic                                                                                                 | 228C             | ⋈ | MULTISET                                                                                                        |
| 226D | ⋈ | NOT EQUIVALENT TO<br>≡ 224D ⋈ 0338 ∅                                                                                            | 228D             | ⋈ | MULTISET MULTIPLICATION<br>→ 2A03 ⋈ n-ary union operator with dot<br>→ 2A40 ⋈ intersection with dot             |
| 226E | ⋈ | NOT LESS-THAN<br>≡ 003C < 0338 ∅                                                                                                |                  |   |                                                                                                                 |
| 226F | ⋈ | NOT GREATER-THAN<br>≡ 003E > 0338 ∅                                                                                             |                  |   |                                                                                                                 |
| 2270 | ⋈ | NEITHER LESS-THAN NOR EQUAL TO<br>≡ 2264 ≤ 0338 ∅                                                                               |                  |   |                                                                                                                 |
| 2271 | ⋈ | NEITHER GREATER-THAN NOR EQUAL TO<br>≡ 2265 ≥ 0338 ∅                                                                            |                  |   |                                                                                                                 |
| 2272 | ⋈ | LESS-THAN OR EQUIVALENT TO<br>~ 2272 FE00 ⋈ following the slant of the lower leg                                                |                  |   |                                                                                                                 |

- 228E  $\uplus$  **MULTISET UNION**  
 = z notation bag addition  
 → 2A04  $\uplus$  n-ary union operator with plus

**Relations**

- 228F  $\sqsubset$  **SQUARE IMAGE OF**  
 2290  $\sqsubset$  **SQUARE ORIGINAL OF**  
 2291  $\sqsubseteq$  **SQUARE IMAGE OF OR EQUAL TO**  
 2292  $\sqsubseteq$  **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  $\models$  **TRUE**  
 = statement is true, valid  
 = is a tautology  
 = satisfies  
 = results in
- 22A9  $\Vdash$  **FORCES**
- 22AA  $\Vdash$  **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  $\nmodels$  **NOT TRUE**  
 $\equiv 22A8 \models 0338 \not\models$
- 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  $\prec$  **PRECEDES UNDER RELATION**  
 → 227A  $\prec$  precedes
- 22B1  $\succ$  **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  $\circleftarrow$  **ORIGINAL OF**
- 22B7  $\circrightarrow$  **IMAGE OF**
- 22B8  $\multimap$  **MULTIMAP**
- 22B9  $\dagger$  **HERMITIAN CONJUGATE MATRIX**

**Operators**

- 22BA  $\intercal$  **INTERCALATE**
- 22BB  $\curlywedge$  **XOR**  
 → 26BA  $\curlywedge$  semisextile
- 22BC  $\nand$  **NAND**  
 → 2305  $\nand$  projective  
 → 26BB  $\nand$  quincunx
- 22BD  $\nabla$  **NOR**

**Miscellaneous mathematical symbols**

- 22BE  $\lrcorner$  **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  $\cap$  intersection
- 22C3  $\bigcup$  N-ARY UNION  
 = z notation generalised union  
 → 222A  $\cup$  union

#### Operators

- 22C4  $\cdot$  DIAMOND OPERATOR  
 → 25C7  $\diamond$  white diamond  
 → 2B29  $\blacklozenge$  black small diamond
- 22C5  $\cdot$  DOT OPERATOR  
 • preferred to 00B7  $\cdot$  for denotation of multiplication  
 → 00B7  $\cdot$  middle dot
- 22C6  $\star$  STAR OPERATOR  
 • APL  
 → 066D  $\star$  arabic five pointed star  
 → 2605  $\blackstar$  black star  
 → 2B50  $\star$  white medium star
- 22C7  $\times$  DIVISION TIMES  
 • ambiguous sign conflating two operators  
 → 00B1  $\pm$  plus-minus sign  
 → 00D7  $\times$  multiplication sign  
 → 00F7  $\div$  division sign  
 → 2715  $\times$  multiplication x

#### Relation

- 22C8  $\bowtie$  BOWTIE  
 → 2445  $\bowtie$  ocr bow tie

#### Operators

- 22C9  $\ltimes$  LEFT NORMAL FACTOR SEMIDIRECT PRODUCT
- 22CA  $\rtimes$  RIGHT NORMAL FACTOR SEMIDIRECT PRODUCT
- 22CB  $\lcurlyeqsucc$  LEFT SEMIDIRECT PRODUCT
- 22CC  $\rcurlyeqsucc$  RIGHT SEMIDIRECT PRODUCT  
 → 2041  $\lambda$  caret insertion point

#### Relation

- 22CD  $\simeq$  REVERSED TILDE EQUALS  
 ~ 22CD FE00  $\simeq$  using lazy S

#### Logical operators

- 22CE  $\curlyvee$  CURLY LOGICAL OR
- 22CF  $\curlywedge$  CURLY LOGICAL AND

#### Relations

- 22D0  $\Subset$  DOUBLE SUBSET
- 22D1  $\Supset$  DOUBLE SUPERSET

#### Operators

- 22D2  $\mho$  DOUBLE INTERSECTION
- 22D3  $\mho$  DOUBLE UNION

#### Relations

- 22D4  $\pitchfork$  PITCHFORK  
 = proper intersection

- 22D5  $\#$  EQUAL AND PARALLEL TO  
 → 2317  $\#$  viewdata square
- 22D6  $\lessdot$  LESS-THAN WITH DOT
- 22D7  $\gtrdot$  GREATER-THAN WITH DOT
- 22D8  $\lll$  VERY MUCH LESS-THAN
- 22D9  $\ggg$  VERY MUCH GREATER-THAN
- 22DA  $\lessgtr$  LESS-THAN EQUAL TO OR GREATER-THAN  
 ~ 22DA FE00  $\lessgtr$  with slanted equal
- 22DB  $\lessgtr$  GREATER-THAN EQUAL TO OR LESS-THAN  
 ~ 22DB FE00  $\lessgtr$  with slanted equal
- 22DC  $\leq$  EQUAL TO OR LESS-THAN  
 → 2A95  $\leq$  slanted equal to or less-than  
 ~ 22DC FE00  $\leq$  with horizontal equal
- 22DD  $\geq$  EQUAL TO OR GREATER-THAN  
 → 2A96  $\geq$  slanted equal to or greater-than  
 ~ 22DD FE00  $\geq$  with horizontal equal
- 22DE  $\leq$  EQUAL TO OR PRECEDES
- 22DF  $\geq$  EQUAL TO OR SUCCEEDS
- 22E0  $\nlessgtr$  DOES NOT PRECEDE OR EQUAL  
 ≡ 227C  $\nlessgtr$  0338  $\nlessgtr$
- 22E1  $\nlessgtr$  DOES NOT SUCCEED OR EQUAL  
 ≡ 227D  $\nlessgtr$  0338  $\nlessgtr$
- 22E2  $\nlessgtr$  NOT SQUARE IMAGE OF OR EQUAL TO  
 ≡ 2291  $\nlessgtr$  0338  $\nlessgtr$
- 22E3  $\nlessgtr$  NOT SQUARE ORIGINAL OF OR EQUAL TO  
 ≡ 2292  $\nlessgtr$  0338  $\nlessgtr$
- 22E4  $\nlessgtr$  SQUARE IMAGE OF OR NOT EQUAL TO
- 22E5  $\nlessgtr$  SQUARE ORIGINAL OF OR NOT EQUAL TO
- 22E6  $\nlessgtr$  LESS-THAN BUT NOT EQUIVALENT TO
- 22E7  $\nlessgtr$  GREATER-THAN BUT NOT EQUIVALENT TO
- 22E8  $\nlessgtr$  PRECEDES BUT NOT EQUIVALENT TO
- 22E9  $\nlessgtr$  SUCCEEDS BUT NOT EQUIVALENT TO
- 22EA  $\nlessgtr$  NOT NORMAL SUBGROUP OF  
 ≡ 22B2  $\nlessgtr$  0338  $\nlessgtr$
- 22EB  $\nlessgtr$  DOES NOT CONTAIN AS NORMAL SUBGROUP  
 ≡ 22B3  $\nlessgtr$  0338  $\nlessgtr$
- 22EC  $\nlessgtr$  NOT NORMAL SUBGROUP OF OR EQUAL TO  
 ≡ 22B4  $\nlessgtr$  0338  $\nlessgtr$
- 22ED  $\nlessgtr$  DOES NOT CONTAIN AS NORMAL SUBGROUP OR EQUAL  
 ≡ 22B5  $\nlessgtr$  0338  $\nlessgtr$

#### Matrix ellipses

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

- 22EE  $\vdots$  VERTICAL ELLIPSIS  
 → 205D  $\vdots$  tricolon  
 → 2026  $\dots$  horizontal ellipsis  
 → FE19  $\vdots$  presentation form for vertical horizontal ellipsis
- 22EF  $\cdots$  MIDLINE HORIZONTAL ELLIPSIS
- 22F0  $\cdotp$  UP RIGHT DIAGONAL ELLIPSIS
- 22F1  $\cdot$  DOWN RIGHT DIAGONAL ELLIPSIS

#### Relations

- 22F2  $\E$  ELEMENT OF WITH LONG HORIZONTAL STROKE
- 22F3  $\E$  ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22F4  $\E$  SMALL ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
- 22F5  $\E$  ELEMENT OF WITH DOT ABOVE
- 22F6  $\E$  ELEMENT OF WITH OVERBAR
- 22F7  $\E$  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<br><small>2205</small><br> zero with long diagonal stroke overlay form<br><small>2205 FE00</small>              |
| 2229                             |  INTERSECTION<br><small>2229</small><br> with serifs<br><small>2229 FE00</small>                                           |
| 222A                             |  UNION<br><small>222A</small><br> with serifs<br><small>222A FE00</small>                                                  |
| 223D                             |  REVERSED TILDE<br><small>223D</small><br> using lazy S<br><small>223D FE00</small>                                        |
| 2242                             |  MINUS TILDE<br><small>2242</small><br> using lazy S<br><small>2242 FE00</small>                                       |
| 2243                             |  ASYMPTOTICALLY EQUAL TO<br><small>2243</small><br> using lazy S<br><small>2243 FE00</small>                           |
| 2248                             |  ALMOST EQUAL TO<br><small>2248</small><br> using lazy S<br><small>2248 FE00</small>                                   |
| 2268                             |  LESS-THAN BUT NOT EQUAL TO<br><small>2268</small><br> with vertical stroke<br><small>2268 FE00</small>                |
| 2269                             |  GREATER-THAN BUT NOT EQUAL TO<br><small>2269</small><br> with vertical stroke<br><small>2269 FE00</small>             |
| 2272                             |  LESS-THAN OR EQUIVALENT TO<br><small>2272</small><br> following the slant of the lower leg<br><small>2272 FE00</small>    |
| 2273                             |  GREATER-THAN OR EQUIVALENT TO<br><small>2273</small><br> following the slant of the lower leg<br><small>2273 FE00</small> |
| 228A                             |  SUBSET OF WITH NOT EQUAL TO<br><small>228A</small><br> with stroke through bottom members<br><small>228A FE00</small>     |
| 228B                             |  SUPERSET OF WITH NOT EQUAL TO<br><small>228B</small><br> with stroke through bottom members<br><small>228B FE00</small>   |
| 2293                             |  SQUARE CAP<br><small>2293</small><br> with serifs<br><small>2293 FE00</small>                                          |
| 2294                             |  SQUARE CUP<br><small>2294</small><br> with serifs<br><small>2294 FE00</small>                                         |
| 2295                             |  CIRCLED PLUS<br><small>2295</small><br> with white rim<br><small>2295 FE00</small>                                    |
| 2297                             |  CIRCLED TIMES<br><small>2297</small><br> with white rim<br><small>2297 FE00</small>                                   |
| 229C                             |  CIRCLED EQUALS<br><small>229C</small><br> with equal sign touching the circle<br><small>229C FE00</small>             |

|      |                                                                                   |                                    |
|------|-----------------------------------------------------------------------------------|------------------------------------|
| 22CD |  | REVERSED TILDE EQUALS              |
|      | 22CD                                                                              |                                    |
|      |  | using lazy S                       |
|      | 22CD FE00                                                                         |                                    |
| 22DA |  | LESS-THAN EQUAL TO OR GREATER-THAN |
|      | 22DA                                                                              |                                    |
|      |  | with slanted equal                 |
|      | 22DA FE00                                                                         |                                    |
| 22DB |  | GREATER-THAN EQUAL TO OR LESS-THAN |
|      | 22DB                                                                              |                                    |
|      |  | with slanted equal                 |
|      | 22DB FE00                                                                         |                                    |
| 22DC |  | EQUAL TO OR LESS-THAN              |
|      | 22DC                                                                              |                                    |
|      |  | with horizontal equal              |
|      | 22DC FE00                                                                         |                                    |
| 22DD |  | EQUAL TO OR GREATER-THAN           |
|      | 22DD                                                                              |                                    |
|      |  | with horizontal equal              |
|      | 22DD FE00                                                                         |                                    |