

Date: 1 December 1998

To: Unicode Technical Committee
ISO/IEC JTC1/SC2/WG2

From: STIX Project of the STIPUB Consortium (a consortium of scientific societies and scientific/technical publishers)

Subject: Request for assignment of codes to mathematical and technical symbols that do not appear in Unicode 2.0 or ISO/IEC 10646

The members of the STIPUB Consortium are all active publishers of mathematical, scientific, and technical books and journals. The following organizations and representatives have contributed to the STIX project:

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AMS is taking the lead in the STIX effort; Karen Ferreira (kmf@ams.org), Director for Electronic Product Development, is the AMS liaison with STIPUB, and the two active participants have experience both with the font requirements of math publishing and in standards work in that area. Barbara Beeton was, until last year, the AMS representative to ISO/IEC JTC1/SC18/WG8; that working group has since been reorganized as JTC1/WG4. Patrick Ion is co-chair of the Math Working Group of the World Wide Web Consortium (W3C).

The charter of the STIX project (Scientific and Technical Information eXchange) is to create one comprehensive set of fonts for scientific and technical publishing. This set of fonts should be adopted and supported by all major STM publishers, and will also be made available for general use under license but free of charge, with the explicit aim to ease and foster the uninhibited flow, exchange, and linking of scientific information.

The rationale is that availability of a universal font set will benefit scientific and technical publishing. For example, it will eliminate certain legal problems with distributing PDF files and publishing on the World Wide Web, and will ease the exchange of documents from different publishers.

Scientific communication and publication via the Web are currently hindered by the absence of both suitable symbol fonts and recognized methods of indicating particular symbols and their relationships to one another. The font problems of ordinary text, which are considerable irrespective of language, have so far been addressed essentially only by the introduction of the ISO 10646/Unicode standard. The special problems of handling technical texts have been examined by the W3C Math Working Group, and their MathML proposal, which is interdependent with this request, was accepted as a W3C Recommendation on 7 April 1998 [see <http://www.w3c.org/Math>]. The work of the HTML-Math WG is also related to the work of the OpenMath consortium.

The STIX group has agreed that a suitable font set should contain at least:

- A suitable selection of alphabets, most in multiple weights (medium and bold), with/without serifs, and orientation/shape (upright and oblique/italic), including
 - Latin alphabet, including digits and punctuation
 - Several other Latin-based alphabets used in mathematics notation
 - Greek alphabet in compatible style(s)
 - Cyrillic alphabet in compatible style(s)
- Mathematical and technical symbols of ISO 10646/Unicode vers. 2.0
- Additional mathematical and technical symbols found in use by STIX

We have also agreed that the basis for the organization of such a font set should be ISO 10646/Unicode. Some arguments in favor of ISO 10646/Unicode are: it is the basis for XML, and therefore for MathML, and it is the character set of the programming language Java and the operating system Windows NT.

In XML documents, and most importantly for use in MathML, one must be able to identify all notation, either by numerical character reference or by entity reference. But numerical character references are ISO 10646/Unicode numbers, since that is the character set underlying XML. If entity names are used, they must still be mapped to something that applications will be able to handle and render.

In the attached charts and lists, we have included only what we believe to be unique symbols. The language of mathematics is fluid, and symbols are defined in context to represent particular mathematical concepts. The tool set of an active mathematician ideally consists of several alphabets, whose members can be distinguished from one another, to represent various classes of variables and constants, and a fairly extensive collection of similarly sized shapes to represent various operations. There are of course many fully “standardized” shapes that are now used almost exclusively to represent particular operations and relations, but even these are sometimes adopted in fields where they are not already in use and redefined to have some other particular meaning. For this reason, the “definitions” accompanying the symbols listed here are in some cases not precise, and even occasionally absent.

The case for alphabets

For a mathematician or other scientist, alphabets provide the symbols to represent ad hoc variables as well as a number of more well-defined concepts. Different styles of alphabets have different meanings, some of which have been formally standardized in some disciplines, but many of which follow only the strength of custom, or even current necessity. Although some letters in some alphabets are generally avoided as being insufficiently distinct from similar letters in other alphabets, the final choice is up to the author. The distinctions made by an author must be retained in a document as distributed, otherwise the meaning becomes unclear or may be lost entirely. There is little redundancy in mathematical expressions; this is different from natural languages, and is the essential reason that multiple alphabets (e.g., Latin, Greek) in multiple styles (e.g., script, fraktur, blackboard bold) are required.

The following alphabetic variations have been found in the literature.

- Latin:
 - lightface upright (with digits) — constants; multiletter combinations; “physical units, mathematical constants, specific mathematical functions, operators, and numbers used as indices” (Y10.20)
 - lightface italic — variables, dimensionless physical quantities (physics)
 - boldface upright (with digits) — vectors (physics), other examples have been found
 - boldface italic — vectors (per Y10.20)
 - lightface sans serif upright (requirement not verified)
 - boldface sans serif upright — (can’t characterize, but have examples)
 - boldface sans serif inclined — tensor quantities of second or higher order (per Y10.20)
- lightface script (calligraphic)
- boldface script
- fraktur
- blackboard bold (with digits, some Greek) — sets (uppercase), fixed objects (lowercase)
- Greek:
 - lightface upright — physical units, mathematical constants (e.g., pi)
 - boldface upright — vectors (physics, e.g., omega = angular velocity)
 - lightface inclined — variables, dimensionless physical quantities (physics)
 - boldface inclined — vectors
 - boldface sans serif upright
 - boldface sans serif inclined — tensor quantities
- Cyrillic
- Hebrew (individual letters only, used as symbols)

It is not necessarily requested that every letter be assigned a separate code. However, it *is* requested that a mechanism be standardized to provide an unambiguous distinction between two different instances of a letter differing only in shape or style; one possible mechanism to accomplish this would be with math variant tags.

Symbols

In the tables that follow, four data elements are given for each symbol:

- a reference ID indicating location in the corresponding chart
- a * if there is an existing symbol in Unicode or another symbol in this collection that appears to be similar
- a one-letter code indicating the class of the symbol:
 - N: normal or ordinary, e.g., symbol used as a variable
 - A: alphabetic; subclass of ordinary
 - D: diacritic
 - P: punctuation
 - B: binary operator, e.g., $a + b$
 - R: relation, e.g., $a = b$
 - L: large operator, e.g. sum, product
 - O: opening delimiter
 - C: closing delimiter
- description of the symbol, or meaning when known

	6X0	6X1	6X2	6X3	6X4	6X5	6X6	6X7	6X8	6X9	6XA	6XB	6XC	6XD	6XE
0	ε	ƒ	Ϝ	Α		α	ϱ	Ϻ	Ϙ	α	ϱ	Ϻ	Ϙ	α	ϱ
1	Θ	ϰ	ϱ	Β		β	ϣ			β	ϣ	Β		β	ϣ
2	Ϝ	Ϟ	ϟ		Ϡ	ϡ	Ϣ	ϣ	Ϥ	ϥ	Ϧ	ϧ	Ϩ	ϩ	Ϫ
3	Ϝ	Λ	δ	Δ	Τ	δ	τ	Δ	Τ	δ	τ	Δ	Τ	δ	τ
4	Ϟ	Γ	ε	Ε	Υ	ε	υ		Υ		υ	Ε	Υ	ε	υ
5	Ϟ	Ι	ι	Ϝ	Ϟ	ϟ	ϡ		Υ	ϟ	ϡ	Ϝ	Ϟ	ϟ	ϡ
6		Ϡ	ϡ	Ω	Ϟ	ϟ	Ϡ	ϡ	Ϣ	ϣ	Ϥ	ϥ	Ϧ	ϧ	Ϩ
7		Χ	ϣ		Χ	ϣ			Χ	ϣ		Χ	ϣ		Χ
8			Π	Ι	Υ	ι	ϣ		Υ	ι	ϣ		Υ	ι	ϣ
9			Σ	Ι		ι	ζ	Ϝ	Ζ	ι	ζ	Ϝ		ι	ζ
A				Κ		κ		Κ		κ		Κ		κ	
B				Λ		λ						Λ		λ	
C				Μ		μ				μ		Μ		μ	
D						ν		Ν		ν		Ν		ν	
E				Ο		ο		Ϟ				Ο		ο	
F						Ρ		Ρ		ρ		Ρ		ρ	

Alphabetsics

- 6X00 A /straightepsilon - small epsilon, Greek
- 6X01 A capital Theta, Greek, straight bar (not Fita, 04E8/27A3)
- 6X02 A old Greek small letter digamma, old Greek
- 6X03 A Greek small letter stigma
- 6X04 A Greek small letter koppa
- 6X05 A Greek small letter sampi

6X10 N function of (italic small letter f)
6X11 A small letter j, no dot
6X12 N turned sans serif capital G, game
6X13 N sans serif capital L
6X14 N turned sans serif capital L
6X15 N reversed sans serif capital L
6X16 N S-sign (sans serif capital S)
6X17 N inverted sans serif capital Y
6X20 N open face digit zero
6X21 N open face digit one
6X22 A CapitalDifferentialD
6X23 A DifferentialD
6X24 A ExponentialE
6X25 A ImaginaryI
6X26 A ImaginaryJ
6X27 A open face Greek small letter gamma
6X28 A open face Greek capital Pi
6X29 L open face sum
6X30 A open face capital A
6X31 A open face capital B
6X33 A open face capital D
6X34 A open face capital E
6X35 A open face capital F
6X36 A open face capital G
6X38 A open face capital I
6X39 A open face capital J
6X3A A open face capital K
6X3B A open face capital L
6X3C A open face capital M
6X3E A open face capital O
6X42 A open face capital S
6X43 A open face capital T
6X44 A open face capital U
6X45 A open face capital V
6X46 A open face capital W
6X47 A open face capital X
6X48 A open face capital Y
6X50 A open face small letter a
6X51 A open face small letter b
6X52 A open face small letter c
6X53 A open face small letter d
6X54 A open face small letter e
6X55 A open face small letter f
6X56 A open face small letter g
6X57 A open face small letter h
6X58 A open face small letter i
6X59 A open face small letter j
6X5A A open face small letter k

6X5B A open face small letter l
6X5C A open face small letter m
6X5D A open face small letter n
6X5E A open face small letter o
6X5F A open face small letter p
6X60 A open face small letter q
6X61 A open face small letter r
6X62 A open face small letter s
6X63 A open face small letter t
6X64 A open face small letter u
6X65 A open face small letter v
6X66 A open face small letter w
6X67 A open face small letter x
6X68 A open face small letter y
6X69 A open face small letter z
6X70 A script letter capital A
6X72 A script letter capital C
6X73 A script letter capital D
6X76 A script letter capital G
6X79 A script letter capital J
6X7A A script letter capital K
6X7D A script letter capital N
6X7E A script letter capital O
6X7F A script letter capital P
6X80 A script letter capital Q
6X82 A script letter capital S
6X83 A script letter capital T
6X84 A script letter capital U
6X85 A script letter capital V
6X86 A script letter capital W
6X87 A script letter capital X
6X88 A script letter capital Y
6X89 A script letter capital Z
6X90 A script letter small a
6X91 A script letter small b
6X92 A script letter small c
6X93 A script letter small d
6X95 A script letter small f
6X97 A script letter small h
6X98 A script letter small i
6X99 A script letter small j
6X9A A script letter small k
6X9C A script letter small m
6X9D A script letter small n
6X9F A script letter small p
6XA0 A script letter small q
6XA1 A script letter small r
6XA2 A script letter small s

6XA3 A script letter small t
6XA4 A script letter small u
6XA5 A script letter small v
6XA6 A script letter small w
6XA7 A script letter small x
6XA8 A script letter small y
6XA9 A script letter small z
6XB0 A fraktur letter capital A
6XB1 A fraktur letter capital B
6XB2 A fraktur letter capital C
6XB3 A fraktur letter capital D
6XB4 A fraktur letter capital E
6XB5 A fraktur letter capital F
6XB6 A fraktur letter capital G
6XB9 A fraktur letter capital J
6XBA A fraktur letter capital K
6XBB A fraktur letter capital L
6XBC A fraktur letter capital M
6XBD A fraktur letter capital N
6XBE A fraktur letter capital O
6XBF A fraktur letter capital P
6XC0 A fraktur letter capital Q
6XC2 A fraktur letter capital S
6XC3 A fraktur letter capital T
6XC4 A fraktur letter capital U
6XC5 A fraktur letter capital V
6XC6 A fraktur letter capital W
6XC7 A fraktur letter capital X
6XC8 A fraktur letter capital Y
6XD0 A fraktur letter small a
6XD1 A fraktur letter small b
6XD2 A fraktur letter small c
6XD3 A fraktur letter small d
6XD4 A fraktur letter small e
6XD5 A fraktur letter small f
6XD6 A fraktur letter small g
6XD7 A fraktur letter small h
6XD8 A fraktur letter small i
6XD9 A fraktur letter small j
6XDA A fraktur letter small k
6XDB A fraktur letter small l
6XDC A fraktur letter small m
6XDD A fraktur letter small n
6XDE A fraktur letter small o
6XDF A fraktur letter small p
6XE0 A fraktur letter small q
6XE1 A fraktur letter small r
6XE2 A fraktur letter small s

6XE3 A fraktur letter small t
6XE4 A fraktur letter small u
6XE5 A fraktur letter small v
6XE6 A fraktur letter small w
6XE7 A fraktur letter small x
6XE8 A fraktur letter small y
6XE9 A fraktur letter small z

	1X0	1X1	1X2	1X3	1X4	1X5	1X6	1X7	1X8
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
A									
B									
C									
D									
E									
F									

Arrows

- 1X00 R down arrow, up arrow
- 1X01 R three right arrows
- 1X02 R left open arrow
- 1X03 R right open arrow
- 1X04 R horizontal open arrow
- 1X05 R if and only if

1X06 R twoheaded mapsto
1X07 * R maps to, double arrow leftward
1X08 * R maps to, double arrow right
1X09 R down arrow with bar
1X0A R up arrow with bar
1X0B R up triple arrow
1X0C R down triple arrow
1X0D R left broken arrow
1X0E R right broken arrow
1X0F R left doubly broken arrow
1X10 R right doubly broken arrow
1X11 R twoheaded right broken arrow
1X12 R right arrow with dotted stem
1X13 R up arrow to bar
1X14 R down arrow to bar
1X15 R right two-headed arrow with tail, bijective mapping
1X16 R left arrow-tail
1X17 R right arrow-tail
1X18 R left double arrow-tail
1X19 R right double arrow-tail
1X1A R left arrow, filled square
1X1B R right arrow, filled square
1X1C R left arrow-bar, filled square
1X1D R right arrow-bar, filled square
1X1E R NW-SE arrow
1X1F R NE-SW arrow
1X20 R NW arrow-hooked
1X21 R NE arrow-hooked
1X22 R SE arrow-hooked
1X23 R SW arrow-hooked
1X24 R NW & NE arrows
1X25 R NE & SE arrows
1X26 R SE & SW arrows
1X27 R SW & NW arrows
1X28 rising diagonal over falling diagonal
1X29 falling diagonal over rising diagonal
1X2A SE arrow over NE arrow
1X2B NE arrow over SE arrow
1X2C falling diagonal over NE arrow
1X2D rising diagonal over SE arrow
1X2E NE arrow over NW arrow
1X2F NW arrow over NE arrow
1X30 * R right arrow-curved
1X31 R not right arrow-curved
1X32 R not right arrow-wavy
1X33 * R left down curved arrow
1X34 * R right down curved arrow
1X35 R left, curved, down arrow

1X36 R right, curved, down arrow
1X37 R left undercurving arrow
1X38 R right undercurving arrow
1X39 R curved right arrow with minus
1X3A R curved left arrow with plus
1X3B * R anticlockwise closed circle arrow
1X3C * R clockwise closed circle arrow
1X3D R left arrow over short right arrow
1X3E R right arrow over short left arrow
1X3F R short right arrow over left arrow
1X40 R right arrow, plus
1X41 R left arrow, plus
1X42 R right arrow through x
1X43 R left and right arrow with a circle
1X44 R up two-headed arrow above circle
1X45 right angle with down zig-zag arrow
1X46 R left-up-right-down harpoon
1X47 R left-down-right-up harpoon
1X48 R up-right-down-left harpoon
1X49 R up-left-down-right harpoon
1X4A R left-up-right-up harpoon
1X4B R up-right-down-right harpoon
1X4C R left-down-right-down harpoon
1X4D R up-left-down-left harpoon
1X4E R left-up harpoon to bar
1X4F R right-up harpoon to bar
1X50 R up-right harpoon to bar
1X51 R down-right harpoon to bar
1X52 R left-down harpoon to bar
1X53 R right-down harpoon to bar
1X54 R up-left harpoon to bar
1X55 R down-left harpoon to bar
1X56 R left-up harpoon from bar
1X57 R right-up harpoon from bar
1X58 R up-right harpoon from bar
1X59 R down-right harpoon from bar
1X5A R left-down harpoon from bar
1X5B R right-down harpoon from bar
1X5C R up-left harpoon from bar
1X5D R down-left harpoon from bar
1X5E R left harpoon-up over left harpoon-down
1X5F R up harpoon-left, up harpoon-right
1X60 R right harpoon-up over right harpoon-down
1X61 R down harpoon-left, down harpoon-right
1X62 R left harpoon-up over right harpoon-up
1X63 R left harpoon-down over right harpoon-down
1X64 R right harpoon-up over left harpoon-up
1X65 R right harpoon-down over left harpoon-down

1X66 R left harpoon-up over long dash
1X67 R left harpoon-down below long dash
1X68 R right harpoon-up over long dash
1X69 R right harpoon-down below long dash
1X6A R up harpoon, down harpoon
1X6B R down harpoon, up harpoon
1X6C R right double arrow with rounded head (looks like thin superset)

Combinations with arrows

1X70 R equal, right arrow below
1X71 R similar, right arrow below
1X72 R approximate, right arrow above
1X73 R left arrow, similar
1X74 R right arrow, similar
1X75 R less than, left arrow
1X76 R left arrow through less than
1X77 R greater than, right arrow
1X78 R subset, right arrow
1X79 R left arrow through subset
1X7A R superset, left arrow

Fish tails

1X80 * R left fish tail
1X81 * R right fish tail
1X82 R up fish tail
1X83 R down fish tail

	2X0	2X1	2X2	2X3	2X4	2X5	2X6	2X7	2X8
0	€	⊘	⊙	ℱ	‡	⊗	⊐	⊑	△
1	⊖	⊗	⊕	ℱ	‡	⊗	⊐	⊑	∇
2	⊖	⊗	⊗	ℱ	‡	⊗	⊐	⊑	∇
3	€		⊕	ℱ	‡	⊗	⊐	⊑	
4	€		⊕	ℱ	‡	⊗	⊐	⊑	
5	€		⊐	ℱ	‡	⊗	⊐	⊑	
6	€		⊐	ℱ	‡	⊗	⊐	⊑	
7	€		⊐	ℱ	‡	⊗	⊐	⊑	
8	€		⊐	ℱ	‡	⊗	⊐	⊑	
9	€		⊐	ℱ	‡	⊗	⊐	⊑	
A	€		⊐	ℱ	‡	⊗	⊐	⊑	
B	€		⊐	ℱ	‡	⊗	⊐	⊑	
C	⊖		⊐	ℱ	‡	⊗	⊐	⊑	
D	⊖		⊐	ℱ	‡	⊗	⊐	⊑	
E	⊖		⊐	ℱ	‡	⊗	⊐	⊑	
F	⊖		⊐	ℱ	‡	⊗	⊐	⊑	

Membership

- 2X00 R set membership, long horizontal stroke
- 2X01 R set membership, vertical bar on horizontal stroke
- 2X02 R large set membership, vertical bar on horizontal stroke
- 2X03 R set membership, dot above
- 2X04 R set membership, bar under
- 2X05 R negated (slash) set membership
- 2X06 R negated set membership, variant
- 2X07 R negated set membership, variant

2X08 R negated set membership, variant
 2X09 R negated set membership, dot above
 2X0A R set membership, two horizontal strokes
 2X0B R negated set membership, two horizontal strokes
 2X0C * back epsilon: such that
 2X0D R contains, long horizontal stroke
 2X0E R contains, vertical bar on horizontal stroke
 2X0F R large contains, vertical bar on horizontal stroke
 2X10 * R negated contains
 2X11 R contains, variant
 2X12 R contains, variant

Large operators

2X20 * L circle dot operator
 2X21 * L circle plus operator
 2X22 * L circle times operator
 2X23 L union operator with dot
 2X24 * L union operator with dot
 2X25 * L square intersection operator
 2X26 * L square union operator
 2X27 * L two logical or operator
 2X28 * L two logical and operator
 2X29 L big times operator
 2X2A L summation with integral
 2X2B L quadruple integral operator
 2X2C * L finite part integral
 2X2D L integral, double barred
 2X2E L integral, average (slashed)
 2X2F * L circulation function
 2X30 L anti clock-wise integration
 2X31 L line integration, rectangular path around pole
 2X32 L line integration, semi-circular path around pole
 2X33 L line integration, not including the pole
 2X34 integral around a point operator
 2X35 * L quaternion integral operator
 2X36 L integral, left arrow with hook
 2X37 L integral, crossed by times sign
 2X38 L integral, overprinted with cap
 2X39 L integral, overprinted with cup
 2X3A L upper integral (bar on top)
 2X3B L lower integral (bar on bottom)
 2X3C L join (large bowtie, relational database theory)
 2X3D L large (operator) left triangle (relational database theory)

Binary operators

2X40	B plus, small circle above
2X41	B plus, circumflex accent above
2X42	B plus, similar above
2X43	B plus sign, dot below
2X44	B plus, similar below
2X45	B plus, two; Nim-addition
2X46	B filled triangle with plus
2X47	B minus, comma above
2X48	B minus sign, dot below
2X49	B plus sign in left half circle
2X4A	B plus sign in right half circle
2X4B	B small, bold times
2X4C	B times, dot
2X4D	B multiply sign, bar below
2X4E	B semidirect product: times sign, bottom closed
2X4F	B smash product
2X50	B multiply sign in left half circle
2X51	B multiply sign in right half circle
2X52	B multiply sign in circle, circumflex accent
2X53	B multiply sign in double circle
2X54 *	B divide in circle
2X55	B plus in triangle
2X56	B minus in triangle
2X57	B multiply in triangle
2X58 *	B interior product
2X59 *	B righthand interior product
2X5A *	B reverse solidus; backward division
2X60 *	B amalgamation or coproduct
2X61	B intersection, with dot
2X62	B bar, union
2X63	B bar, intersection
2X64	B intersection, and
2X65	B union, or
2X66	B union above intersection
2X67	B intersection above union
2X68	B union, bar, intersection
2X69	B intersection, bar, union
2X6A	B union, union, joined
2X6B	B intersection, intersection, joined
2X6C	B union, serifs
2X6D	B intersection, serifs
2X6E	B closed union, serifs
2X6F	B closed intersection, serifs
2X70	B square union, serifs
2X71	B square intersection, serifs

2X72 B closed union, serifs, smash product
2X73 B with dot
2X74 B ith dot
2X75 * B double logical and
2X76 * B double logical or
2X77 * B two logical and
2X78 * B two logical or
2X79 B sloping large or
2X7A B sloping large and
2X7B B and with middle stem
2X7C B or with middle stem
2X7D B or, horizontal dash
2X7E B and, horizontal dash
2X7F * B double bar over large wedge
2X80 * B wedge, bar below
2X81 B /veebar B: logical or, bar below
2X82 * B logical or, double bar below (large vee)

	3X0	3X1	3X2	3X3	3X4	3X5	3X6	3X7	3X8	3X9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										
A										
B										
C										
D										
E										
F										

Relations: equal, similar, inequalities

- 3X00 R equal, dot below
- 3X01 R not equal, dot
- 3X02 R reverse not equal
- 3X03 R reverse not equivalent
- 3X04 R similar, dot
- 3X05 * R not equal or similar

3X06 * R not approximately identical to
 3X07 R congruent, dot
 3X08 R not congruent, dot
 3X09 * R reverse congruent
 3X0A R approximate, circumflex accent
 3X0B R approximately equal or equal to
 3X0C R not approximately equal or equal to
 3X0D equal, plus
 3X0E B plus, equals
 3X0F * R equal, similar
 3X10 R double colon, equals
 3X11 R two consecutive equal signs
 3X12 * R equal with four dots
 3X13 R equivalent, four dots above
 3X14 R less than, circle inside
 3X15 R greater than, circle inside
 3X16 R less than, questionmark above
 3X17 R greater than, questionmark above
 3X18 * R less-than-or-equal, slanted
 3X19 * R greater-or-equal, slanted
 3X1A R less-than-or-equal, slanted, dot inside
 3X1B R greater-than-or-equal, slanted, dot inside
 3X1C R less-than-or-equal, slanted, dot above
 3X1D R greater-than-or-equal, slanted, dot above
 3X1E R less-than-or-equal, slanted, dot above right
 3X1F R greater-than-or-equal, slanted, dot above left
 3X20 * R less, approximate
 3X21 * R greater, approximate
 3X22 * R less, not equals
 3X23 * R greater, not equals
 3X24 * R less, not approximate
 3X25 * R greater, not approximate
 3X26 * R not less-than-or-equal
 3X27 * R not greater-than-or-equal
 3X28 * R not less, double equals
 3X29 * R not greater, double equals
 3X2A * R less, equal, slanted, greater
 3X2B * R greater, equal, slanted, less
 3X2C * R less, double equals, greater
 3X2D * R greater, double equals, less
 3X2E R less, similar, equal
 3X2F R greater, similar, equal
 3X30 R less, similar, greater
 3X31 R greater, similar, less
 3X32 R less, greater, equal
 3X33 R greater, less, equal
 3X34 R less, equal, slanted, greater, equal, slanted
 3X35 R greater, equal, slanted, less, equal, slanted

3X36 * R equal-or-less, slanted
 3X37 * R equal-or-greater slanted
 3X38 R equal-or-less, slanted, dot inside
 3X39 R equal-or-greater, slanted, dot inside
 3X3A * R similar, less
 3X3B * R similar, greater
 3X3C R similar, less, equal
 3X3D R similar, greater, equal
 3X40 R double nested less-than sign; absolute continuity
 3X41 R double nested greater-than sign
 3X42 R double less-than with underbar
 3X43 * R not double less-than sign
 3X44 * R not double greater-than sign
 3X45 R not much less than, variant
 3X46 R not much greater than, variant
 3X47 R not triple less than
 3X48 R not triple greater than
 3X49 R greater, less, overlapping
 3X4A R greater, less, apart
 3X4B R less than, closed by curve
 3X4C R greater than, closed by curve
 3X4D R less than, closed by curve, equal, slanted
 3X4E R greater than, closed by curve, equal, slanted
 3X50 R smaller than
 3X51 R larger than
 3X52 R smaller than or equal
 3X53 R larger than or equal
 3X54 R smaller than or equal, slanted
 3X55 R larger than or equal, slanted
 3X56 * R not bumpy equals
 3X57 R not bumpy single equals
 3X58 * R bumpy, double equals

Relations: precede, succeed

3X60 * R succeeds, equals
 3X61 * R precedes, equals
 3X62 * R precedes, double equals
 3X63 * R succeeds, double equals
 3X64 * R precedes, not double equals
 3X65 * R succeeds, not double equals
 3X66 * R succeeds, approximate
 3X67 * R precedes, approximate
 3X68 * R precedes, not approx
 3X69 * R succeeds, not approx
 3X6A * R not precedes, equals
 3X6B * R not succeeds, equals

3X6C * R not precedes, similar
3X6D * R not succeeds, similar
3X6E R double precedes
3X6F R double succeeds

Relations: subset, superset

3X70 R subset, with dot
3X71 R superset, with dot
3X72 R subset, plus
3X73 R superset, plus
3X74 R subset, multiply
3X75 R superset, multiply
3X76 R subset, equals, dot
3X77 R superset, equals, dot
3X78 * R subset, double equals
3X79 * R superset, double equals
3X7A R subset, similar
3X7B R superset, similar
3X7C * R subset, not equals, variant
3X7D * R superset, not equals, variant
3X7E * R subset, not double equals
3X7F * R superset, not double equals
3X80 * R subset not double equals, variant
3X81 * R superset not double equals, variant
3X82 * R not subset, double equals
3X83 * R not superset, double equals
3X84 * R not, square subset
3X85 * R not, square superset
3X86 R subset, closed
3X87 R superset, closed
3X88 R subset, closed, equals
3X89 R superset, closed, equals
3X8A R subset above superset
3X8B R superset above subset
3X8C R subset above subset
3X8D R superset above superset
3X8E R superset, subset
3X8F R superset, subset, dash joining them

Relations: forks

3X90 R fork, variant
3X91 R fork with top
3X92 * R transversal intersection
3X93 R forking (slashed, although positive)
3X94 R nonforking (negative, slash absent)

	4X0	4X1	4X2	4X3	4X4	4X5	4X6
0	≡]	—	Ǝ	⊥	⊘
1	≡		[—	∩	⊥	⊘
2	≡]	—	∩	⊥	⊘
3	≡		⊂	—	∩	⊥	⊘
4	⊥		⊃	—	∩	⊥	⊘
5	⊥	⊂	⊃	—	//	⊥	⊘
6	≡	⊂	⊃		⊥	⊥	⊘
7	≡	⊂	⊃			⊥	⊘
8	≡	⊂	⊃		⋮	⊥	
9	≡	⊂	⊃		⋮	⊥	
A	≡	⊂	⊃		⋮	⊥	
B	≡	⊂	⊃		⋮		
C	≡	⊂	⊃				
D		[
E]					
F		[

Turnstiles

- 4X00 R vertical, triple dash; ordinarily satisfies
- 4X01 R dash, double vertical
- 4X02 R double dash, vertical
- 4X03 * R vertical, dash (long)
- 4X04 R vert, low bar to left from base
- 4X05 R vert, low bar to right from base

4X06 R vert, double bar (over)
 4X07 R vert, double bar (under)
 4X08 R double bar, vert over and under
 4X09 R double vert, bar over
 4X0A * R double vert, bar (under) (independence, probability theory)
 4X0B R not with two horizontal strokes
 4X0C R reverse not with two horizontal strokes

Delimiters

4X10 O left vertical delimiter
 4X11 C right vertical delimiter
 4X12 O left double vertical delimiter
 4X13 C right double vertical delimiter
 4X14 triple vertical bar (fence)
 4X15 O left white parenthesis
 4X16 C right white parenthesis
 4X17 * O left white bracket
 4X18 * C right white bracket
 4X19 O left white brace
 4X1A C right white brace
 4X1B * O left white angular bracket
 4X1C * C right white angular bracket
 4X1D O left bracket, equal
 4X1E C right bracket, equal
 4X1F O left bracket, reverse solidus top corner
 4X20 C right bracket, reverse solidus bottom corner
 4X21 O left bracket, solidus bottom corner
 4X22 C right bracket, solidus top corner
 4X23 O left angle, dot
 4X24 C right angle, dot
 4X25 * O O: left parenthesis, less
 4X26 * C C: right paren, greater
 4X27 double left parenthesis, greater
 4X28 double right parenthesis, less
 4X29 less than, right arc
 4X2A greater than, left arc
 4X2B right moustache
 4X2C left moustache
 4X30 over parenthesis
 4X31 under parenthesis
 4X32 over bracket
 4X33 under bracket
 4X34 over brace
 4X35 under brace

Vertical non-delimiters

4X40 R reverse nmid
4X41 R circle, mid below
4X42 R mid, circle below
4X43 N top, circle below
4X44 R parallel, similar
4X45 R parallel, slanted
4X46 R not parallel, slanted
4X47 B triple vertical bar (binary operator)
4X48 doubly broken vert
4X49 three close dots vertical (ellipsis)
4X4A four close dots vertical (ellipsis)
4X4B vertical zig-zag line

Angles

4X50 right angle, variant [with square]
4X51 right angle-measured, dot
4X52 angle, s inside
4X53 angle (acute), inverted
4X54 angle, down and left
4X55 angle, up and left
4X56 angle, equal
4X57 reverse angle, equal
4X58 not, vert, angle
4X59 large downward pointing angle
4X5A large upward pointing angle
4X60 angle-measured, arrow, up, right
4X61 angle-measured, arrow, up, left
4X62 angle-measured, arrow, down, right
4X63 angle-measured, arrow, down, left
4X64 angle-measured, arrow, right, up
4X65 angle-measured, arrow, left, up
4X66 angle-measured, arrow, right, down
4X67 angle-measured, arrow, left, down

	5X0	5X1	5X2	5X3	5X4
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
A					
B					
C					
D					
E					
F					

	7X0	7X1	7X2	7X3	7X4
0	*	-	-	▽	◆
1	////	;		▽	▭
2	∧	...	∪	▽	*
3	≈	≠	⇒	▽	♀
4	∧	7	■	▽	♀
5	≡	∖	≠	▴	♀
6	≈	/		▴	♀
7	...	∖		□	♀
8	≡	∖		■	♀
9	≡	∖		■	♀
A	≈]		□	♀
B	≈]		■	
C	⊙			□	
D		⊗		■	
E				◆	
F				◆	

Empty set, circles, squares, triangles

- 5X00 N reversed circle, slash
- 5X01 N circle, slash, bar above
- 5X02 N circle, slash, small circle above
- 5X03 N circle, slash, right arrow above
- 5X04 N circle, slash, left arrow above
- 5X05 * circle with horizontal bar

5X06 two horizontal bars in circle
 5X07 B circle with vertical bar
 5X08 * B vertical bar in circle
 5X09 B parallel in circle
 5X0A B reverse solidus in circle
 5X0B B perpendicular in circle
 5X0C circle, horizontal bar, top divided by vertical
 5X0D circle, cross
 5X0E dot, solidus, dot in circle
 5X0F circle with up arrow through it
 5X10 large circle in circle
 5X11 filled circle in circle
 5X12 * less-than in circle
 5X13 * greater-than in circle
 5X14 circle, small circle to the right
 5X15 circle, two horizontal strokes to the right
 5X16 * solidus in square
 5X17 * reverse solidus in square
 5X18 asterisk in box
 5X19 small circle in box
 5X1A B box within box
 5X1B two joined squares
 5X20 triangle, dot over
 5X21 * triangle, bar under
 5X22 S in triangle
 5X23 B triangle, serifs at bottom
 5X24 * R not, vert, left triangle, equals
 5X25 * R not, vert, right triangle, equals
 5X26 R right triangle above left triangle
 5X27 R left triangle, vertical bar
 5X28 R vertical bar, right triangle
 5X29 R not left triangle, vertical bar
 5X2A R not vertical bar, right triangle

Bowtie, hourglass

5X30 R left filled bowtie
 5X31 R right filled bowtie
 5X32 R filled bowtie
 5X33 R left filled x (cf. 22C9)
 5X34 R right filled x (cf. 22CA)
 5X35 hourglass plus (open)
 5X36 filled hourglass

Miscellaneous relations

5X40 most positive
5X41 congruence sign (lazy S)
5X42 reverse most positive, line below
5X43 most positive, two lines below
5X44 * R proportional, variant
5X45 N infinity sign, incomplete
5X46 N tie, infinity
5X47 N not, vert, infinity
5X48 R double-ended version of multimap
5X49 N D'Alembertian (square with contoured outline)
5X4A R increases as; wedge over bar
5X4B shuffle product
5X4C R parallel, slanted, equal; homothetically congruent to
5X4D R similar, parallel, slanted, equal
5X4E R equivalent, equal; congruent and parallel
5X4F R top arc over bottom arc

Embellishments, diacritics, combining symbols

7X00 low asterisk
7X01 * N quadruple prime
7X02 D double circumflex
7X03 D double tilde
7X04 D accent caret over dot
7X05 D double dot over bar over
7X06 D tilde over bar over
7X07 D triple underdot
7X08 D triple underbar
7X09 D quadruple underbar
7X0A D straight over wavy underline
7X0B D wavy over straight underline
7X0C annuity symbol, actuarial bend

Punctuation and similar

7X10 P hyphen
7X11 reverse semi-colon
7X12 P em leader
7X13 N two asterisks, aligned vertically
7X14 solidus, bar above
7X15 reversed solidus, bar through
7X16 big forward slash
7X17 big backward slash
7X18 * falling diagonal

7X19 * rising diagonal
7X1A top square bracket
7X1B bottom square bracket
7X1C bottom above top square bracket
7X1D N turned ampersand

Miscellanea

7X20 short horizontal line
7X21 N significant blank symbol
7X22 N round space indicator
7X23 rule-delayed (colon right arrow)
7X24 N histogram marker
7X25 N thermodynamic (vertical bar crossed by two horizontals)

Geometric shapes

7X30 N ACS: tridls -- down-pointing triangle with left half black
7X31 N ACS: tridrs -- down-pointing triangle with right half black
7X32 upper left triangle
7X33 upper right triangle
7X34 lower left triangle
7X35 lower left triangle, filled
7X36 upper right triangle, filled
7X37 N large white square
7X38 N large filled square
7X39 N large closed square
7X3A N empty small square
7X3B N filled small square
7X3C N empty very small square
7X3D N filled very small square
7X3E N white diamond with centered dot
7X3F N filled diamond with down arrow
7X40 lozenge, filled
7X41 N trapezium
7X42 N sextile (6-pointed star)
7X43 N circle with down arrow
7X44 N filled circle with down arrow
7X45 N error-barred white square
7X46 N error-barred filled square
7X47 N error-barred white diamond
7X48 N error-barred filled diamond
7X49 N error-barred white circle
7X4A N error-barred filled circle

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