



UTC-Review: Unicode Technical Report #25

UNICODE SUPPORT FOR MATHEMATICS

Version	1.0
Authors	Barbara Beeton (bnb@ams.org), Asmus Freytag (asmus@unicode.org), Murray Sargent III (murrays@microsoft.com)
Date	2003-05-22 Version for UTC-Review
This Version	http://www.unicode.org/unicode/reports/tr25/tr25-6.html
Previous Version	http://www.unicode.org/unicode/reports/tr25/tr25-5.html
Latest Version	http://www.unicode.org/unicode/reports/tr25
Tracking Number	<u>6</u>

Summary

Starting with version 3.2, Unicode includes virtually all of the standard characters used in mathematics. This set supports a variety of math applications on computers, including document presentation languages like TeX, math markup languages like MathML and OpenMath, internal representations of mathematics in systems like Mathematica, Maple, and MathCAD, computer programs, and plain text. This technical report describes the Unicode mathematics character groups and gives some of their imputed default math properties.

Status

This document has been reviewed by Unicode members and other interested parties, and has been approved by the Unicode Technical Committee as a Unicode Technical Report. This is a stable document and may be used as reference material or cited as a normative reference by other specifications.

A Unicode Technical Report (UTR) contains informative material. Conformance to the Unicode Standard does not imply conformance to any UTR. Other specifications, however, are free to make normative references to a UTR.

Please submit corrigenda and other comments with the online reporting form [[Feedback](#)]. Related information that is useful in understanding this document is found in the [References](#) section. For the latest version of the Unicode Standard see [[Unicode](#)]. See [[Reports](#)] for a list of current Unicode Technical Reports. For more information about versions of the Unicode Standard, see [[Versions](#)].

[Ed.: Notes to reviewers are shown in square brackets and in the style of this note. Major changes in the text are highlighted. This *non-public UTC review version* incorporates many review comments by the mathematical community based on the current public draft. The authors are proposing that the UTC approve the document as UTR based on the current revision.]

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1 Overview

All of Science and technology uses formulas, equations and mathematical notation as part of the language of the subject. This report presents a discussion of the mathematics character repertoire of the Unicode Standard [Unicode] as used for mathematics, but it is intended that this discussion apply to mathematical notation in general.

As described in the forthcoming Unicode Character Property Model [PropMod], each Unicode character has associated character properties. This report describes the properties relevant to the mathematics character repertoire, including a number of properties that are not yet part of the Unicode Standard, and details character classifications by usage and by typography. In addition, this report gives some implementation guidelines for input methods and use of Unicode math characters in programming languages.

Some of the text of the character block descriptions in the Unicode Standard was based on early drafts of this report; as a result there is significant overlap, although the focus of the presentation is different. As always, wherever there is a discrepancy, the text of the Standard has precedence.

The notational conventions follow the use in [Unicode]. Due to limitations of the plain HTML format of this report, examples of mathematical formulas are shown in larger size than would be typical for a mathematical paper, and their layout, spacing and vertical alignment are merely approximations of the correct appearance.

2 Mathematical Character Repertoire

The Unicode Standard provides a quite complete set of standard math characters to support publication of mathematics on and off the web. In addition to the 340 math-specific symbols already encoded in Unicode 3.0, Unicode 3.1 introduced 996 new alphanumeric symbols and Unicode 3.2 introduced 591 new symbols, for a total of 1929 mathematical symbols, including the addition of 1 alphanumeric symbol and 1 other symbol in Unicode 4.0. This repertoire is the result of input from many sources, notably from the STIX Project (Scientific and Technical Information Exchange) [STIX], a collaborative project of scientific and technical publishers. The STIX collection includes, but is not limited to, symbols gleaned from mathematical publications by experts from the American Mathematical Society (AMS) and symbol sets provided by Elsevier Publishing and by the American Physical Society. The new repertoire enables the display of virtually all standard mathematical symbols. Nevertheless no collection of mathematical symbols can ever be considered complete; mathematicians and other scientists are continually inventing new mathematical symbols and the plan is to add them as they become widely accepted in the scientific communities.

Mathematical Markup Language (MathML™) [MathML], an XML application [XML], is a major beneficiary of the increased repertoire for mathematical symbols. The W3C Math Working Group, which developed MathML, lobbied in favor of the inclusion of the new characters. In addition, the new characters lend themselves to direct plain text encoding of mathematics for various purposes which can be much more compact than MathML or T_EX, the typesetting language and program designed by Donald Knuth [TeX] (see [Section 4, Implementation Guidelines](#)).

2.1 Mathematical Alphanumeric Symbols Block

The Mathematical Alphanumeric Symbols block (U+1D400—U+1D7FF) contains a large collection of letterlike symbols for use in mathematical notation, typically for variables. The characters in this block are intended for use only in mathematical or technical notation; they are not intended for use in non-technical text. When used with markup languages, for example with MathML the characters are expected to be used directly, instead of indirectly via entity references or by composing them from base letters and style markup.

Words Used as Variables. In some specialties, whole words are used as variables, not just single letters. For these cases, style markup is preferred because in ordinary mathematical notation the juxtaposition of variables generally implies multiplication, or some other composition, not word formation as in ordinary text. Markup not only provides the necessary scoping in these cases, it also allows the use of a more extended alphabet.

2.2 Mathematical Alphabets

Basic Set of Alphanumeric Characters. Mathematical notation uses a basic set of mathematical alphanumeric characters which consists of:

- the set of basic Latin digits (0 – 9) (U+0030..U+0039)
- the set of basic upper- and lowercase Latin letters (a – z, A – Z)
- the uppercase Greek letters Α – Ω (U+0391..U+03A9), plus the nabla ∇ (U+2207) and the variant of theta Θ given by U+03F4
- the lowercase Greek letters α – ω (U+03B1..U+03C9), plus the partial differential sign ∂ (U+2202) and the six glyph variants of ε, θ, κ, φ, ρ, and π, given by U+03F5, U+03D1, U+03F0, U+03D5, U+03F1, and U+03D6.

For some characters in the basic set of Greek characters, two variants of the same character are included. This is because they can appear in the same mathematical document with different meanings, even though they would have the same meaning in Greek text.

Mathematical Accents. The diacritics, or accents, in mathematical text usually have special semantic significance different from that of changing the pronunciation of a letter, as is the case for text accents. Because the use of text accents such as the acute accent would interfere with common mathematical diacritics, only unaccented forms of the letters are used for mathematical notation. Examples of common mathematical diacritics that can be confused with text accents are the circumflex, macron, or the single or double dot above, the latter two of which are commonly used in physics to denote derivatives with respect to the time variable.

Mathematical symbols with diacritics are always represented by combining character sequences, except as required by normalization. See [Unicode Standard Annex #15, "Unicode Normalization Forms"](#) [Normalization] for more information. Note that normalization leaves all characters in the Mathematical Alphanumeric Symbols and Letterlike Symbols blocks unaffected. These blocks contain nearly all alphabetic characters used as math symbols.

Additional Characters. In addition to this basic set, mathematical notation also uses the four Hebrew-derived characters (U+2135..U+2138), for example in ℵ₀ for the first transfinite cardinal. Occasional uses of other alphabetic and numeric characters are known. Examples include U+0428 CYRILLIC CAPITAL LETTER SHA, U+306E HIRAGANA LETTER NO , the ideograph U+4E2D 中 and Eastern Arabic–Indic digits (U+06F0..U+06F9). However, unlike the characters in the mathematical alphabets, these characters are only used in a single, basic form.

Semantic Distinctions. Mathematics has need for a number of Latin and Greek alphabets that on first thought appear to be mere font variations of one another. For example the letter H can appear as plain or upright (H), bold (H), italic (H), and script H. However in any given document, these characters have distinct, and usually unrelated mathematical semantics. For example, a normal H represents a different variable from a bold H, *etc.* If these attributes are dropped in plain text, the distinctions are lost and the meaning of the text is altered. Without the distinctions, the well-known Hamiltonian formula:

$$\mathcal{H} = \int d\tau (\epsilon E^2 + \mu H^2),$$

turns into the *integral* equation in the variable H:

$$H = \int d\tau (\epsilon E^2 + \mu H^2).$$

By encoding a separate set of alphabets, it is possible to preserve such distinctions in plain text.

Mathematical Alphabets. The alphanumeric symbols encountered in mathematics are given in the following table:

Table 2.1 Mathematical Alphabets

Math Style	Characters from Basic Set	Location
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plain (upright, serified)	Latin, Greek and digits	BMP
bold	Latin, Greek and digits	Plane 1
italic	Latin and Greek	Plane 1 *
bold italic	Latin and Greek	Plane 1
script (calligraphic)	Latin	Plane 1 *
bold script (calligraphic)	Latin	Plane 1
Fraktur	Latin	Plane 1 *
bold Fraktur	Latin	Plane 1
double-struck	Latin and digits	Plane 1 *
sans-serif	Latin and digits	Plane 1
sans-serif bold	Latin, Greek and digits	Plane 1
sans-serif italic	Latin	Plane 1
sans-serif bold italic	Latin and Greek	Plane 1
monospace	Latin and digits	Plane 1

* Some of these alphabets have characters in the BMP as noted in the following section.

The plain letters have been unified with the existing characters in the Basic Latin and Greek blocks. There are 24 double-struck, italic, Fraktur and script characters that already exist in the Letterlike Symbols block (U+2100—U+214F). These are explicitly unified with the characters in this block and corresponding holes have been left in the mathematical alphabets.

Compatibility Decompositions. All mathematical alphanumeric symbols have compatibility decompositions to the base Latin and Greek letters—folding away such distinctions, however, is usually not desirable as it loses the semantic distinctions for which these characters were encoded. See [Unicode Standard Annex #15, "Unicode Normalization Forms"](#) [Normalization] for more information.

2.3 Fonts Used for Mathematical Alphabets

Mathematicians place strict requirements on the *specific* fonts being used to represent mathematical variables. Readers of a mathematical text need to be able to distinguish single letter variables from each other, even when they do not appear in close proximity. They must be able to recognize the letter itself, whether it is part of the text or is a mathematical variable, and lastly which mathematical alphabet it is from.

Fraktur. The black letter style is often referred to as *Fraktur* or *Gothic* in various sources. Technically, Fraktur and Gothic typefaces are distinct designs from black letter, but any of several font styles similar in appearance to the forms shown in the charts can be used.

Math italics. Mathematical variables are most commonly set in a form of italics, but not all italic fonts can be used successfully. In common text fonts, the *italic letter v* and *Greek letter nu* are not very distinct. A rounded *italic letter v* is therefore preferred in a mathematical font, as long as it is distinct from the *Greek upsilon*. There are other characters, which sometimes have similar shapes and require special attention to avoid ambiguity. Examples are shown in the table below.

italic a	<i>a</i>	α	alpha
italic v (pointed)	<i>ν</i>	ν	nu
italic v (rounded)	<i>υ</i>	υ	upsilon
script X	<i>ℵ</i>	χ	chi
plain Y	Υ	Υ	Upsilon

Theorems are commonly printed in a text italic font. A font intended for mathematical variables should support clear visual distinctions so that variables can be reliably separated from italic text in a theorem. Some languages have common single letter words (English *a*, Scandinavian *i*, etc.), which can otherwise be easily confused with common variables.

Hard-to-distinguish Letters. Not all sans-serif fonts allow an easy distinction between *lowercase l*, and *uppercase l* and not all monospaced (fixed width) fonts allow a distinction between the *letter 1* and the *digit 1*. Such fonts are not usable for mathematics. In Fraktur, the letters $\mathfrak{3}$ and \mathfrak{z} in particular must be made distinguishable. Overburdened Black Letter forms like \mathfrak{J} and \mathfrak{I} are inappropriate. Similarly, the *digit zero* must be distinct from the *uppercase letter O*, and the empty set \emptyset must be distinct from the *letter o with stroke* for all mathematical alphanumeric sets. Some characters are so similar that even mathematical fonts do not attempt to provide distinguished glyphs for them. Their use is normally avoided in mathematical notation unless no confusion is possible in a given context, for example *uppercase A* and *uppercase Alpha* (A).

Font Support for Combining Diacritics. Mathematical equations require that characters be combined with diacritics (dots, tilde, circumflex, or arrows above are common), as well as followed or preceded by super- or subscripted letters or numbers. This requirement leads to designs for *italic* styles that are less inclined, and *script* styles that have smaller overhangs and less slant than equivalent styles commonly used for text such as wedding invitations.

Typestyle for Script Characters. In some instances, a deliberate unification with a non-mathematical symbol has been undertaken; for example, U+2133 SCRIPT CAPITAL M is unified with the pre-1949 symbol for the German currency unit *Mark*. This unification restricts the range of glyphs that can be used for this character in the charts. Therefore the font used for the reference glyphs in the code charts uses a simplified ‘English Script’ style, as recommended by the American Mathematical Society. For consistency, other script characters in the Letterlike Symbols block are now shown in the same typestyle.

The two characters U+2113 SCRIPT SMALL L, and U+2118 SCRIPT CAPITAL P, are not regular script characters, despite their character names. The latter is the symbol for the *Weierstrass elliptic function*, a calligraphic letter shape based on the small p, and the former is derived from a special italic letter shape called an ‘ell’, and is unified with the common non-SI symbol for the liter [l]. The characters U+1D4C1 SCRIPT SMALL L and U+1D4A8 SCRIPT CAPITAL P are the preferred characters for the script style.

Double-struck Characters. The double-struck glyphs shown in earlier editions of the standard attempted to match the design used for all the other Latin characters in the standard, which is based on Times. The current set of fonts for use in the character code charts was prepared after consultation with the American Mathematical Society and leading publishers of mathematics, and shows much simpler forms that are derived from the forms written on a blackboard. However, this font represents just one possible representation of double-struck characters; both serifed and non-serifed forms can be used in mathematical texts, and inline fonts are found in works published by certain publishers. Some fonts differ in which strokes of a character to double, for example the left or right leg of the *uppercase A*. There is no intention to support any of these stylistic preferences via character encoding, therefore only one set of double struck mathematical alphanumeric symbols have been encoded.

2.3.1 Reference Glyphs for Greek Phi

With Unicode 3.0 and the concurrent second edition of ISO/IEC 10646-1, the reference glyphs for U+03C6 GREEK LETTER SMALL PHI and U+03D5 GREEK PHI SYMBOL were exchanged. In ordinary Greek text, the character U+03C6 is used exclusively, although this character has considerably glyphic variation, sometimes represented with a glyph more like the representative glyph shown for U+03C6 (the “loopy” form) and less often with a glyph more like the representative glyph shown for U+03D5 (the “straight” form).

For mathematical and technical use, the straight form of the small phi is an important symbol and needs to be consistently distinguishable from the loopy form. The straight form phi glyph is used as the representative glyph for the symbol phi at U+03D5 to satisfy this distinction.

The assignment of representative glyphs had been the reverse in versions of the Unicode Standard prior to Unicode 3.0. This

resulted in the problem that the character explicitly identified as the mathematical symbol did not have the straight form of the character that is the preferred glyph for that use. Furthermore, it made it unnecessarily difficult for general purpose fonts supporting ordinary Greek text to also add support for Greek letters used as mathematical symbols. This resulted from the fact that many of those fonts already used the loopy form glyph for U+03C6, as preferred for Greek body text; to support the phi symbol as well, they would have had to disrupt glyph choices already optimized for Greek text.

When mapping symbol sets or SGML entities to the Unicode Standard, it is important to make sure that codes or entities, such as phi1, that require the straight form of the phi symbol be mapped to U+03D5 and not to U+03C6. Mapping to the latter should be reserved for codes or entities that represent the small phi as used in ordinary Greek text.

Fonts used primarily for Greek text may use either glyph form for U+03C6, but fonts that also intend to support technical use of the Greek letters should use the loopy form to ensure appropriate contrast with the straight form used for U+03D5.

2.3.2 Reference Glyphs for 2278 and 2279

In Unicode 3.2 the reference glyphs for 2278 NEITHER LESS–THAN NOR GREATER–THAN and 2279 NEITHER GREATER–THAN NOR LESS–THAN are changed from using a vertical cancellation to using a slanted cancellation. This change was made in order to match their the long standing canonical decompositions for these characters, which use 0338 COMBINING LONG SOLIDUS OVERLAY. Irrespective of this change to the reference glyphs, the symmetric forms using the vertical stroke remain acceptable glyph variants. Using 2275 or 2276 followed by 20D2 COMBINING LONG VERTICAL LINE OVERLAY will encode these upright variants explicitly.

Unless fonts are created with the intention to add support for both forms (via VS1 for the upright forms) there is no need to revise the glyphs for 2287 and 2279 in existing fonts: the glyphic range implied by using the base character alone encompasses both shapes.

2.4 Locating Mathematical Characters

Mathematical characters can be located by looking in the blocks that contain such characters or by checking the Unicode MATH property, which is assigned to characters that naturally appear in mathematical contexts (see [Section 3 "Mathematical Character Properties"](#)). Mathematical characters can be found in the following blocks:

Table 2.2 Locations of Mathematical Characters

Block Name	Range	Character Types
Basic Latin	U+0021–U+007E	Variables, operators, digits*
Greek	U+0370–U+03FF	Variables*
General Punctuation	U+2000–U+206F	Spaces, Invisible operators*
Letterlike Symbols	U+2100–U+214F	Variables*
Arrows	U+2190–U+21FF	Arrows, arrow–like operators
Mathematical Operators	U+2200–U+22FF	Operators
Miscellaneous Technical Symbols	U+2300–U+23FF	Braces, operators*
Geometrical Shapes	U+25A0–U+25FF	Symbols
Misc. Mathematical Symbols–A	U+27C0–U+27EF	Symbols and operators
Supplemental Arrows–A	U+27F0–U+27FF	Arrows, arrow–like operators
Supplemental Arrows–B	U+2900–U+297F	Arrows, arrow–like operators
Misc. Mathematical Symbols–B	U+2980–U+29FF	Braces, symbols
Suppl. Mathematical Operators	U+2A00–U+2AFF	Operators
Misc. Symbols and Arrows	U+2B00–U+2BFF	Arrows, operators or symbols
Mathematical Alphanumeric Symbols	U+1D400–U+1D7FF	Variables and digits
Other blocks	...	Characters for occasional use

*This block contains non-mathematical characters as well.

2.5 Duplicated Characters

Some Greek letters are re-encoded as technical symbols. These include U+00B5 μ MICRO SIGN, U+2126 Ω OHM SIGN, and several characters among the APL functional symbols in the Miscellaneous Technical block. U+03A9 Ω GREEK LETTER CAPITAL OMEGA is the canonical equivalent of U+2126 and its use is preferred. Micro sign is included in several parts of ISO/IEC 8859, and therefore supported in many legacy environments where U+03BC GREEK LETTER SMALL MU is not available. Because of that, implementations need to be able to recognize it, even though *mu* is the preferred character in a Unicode context.

Latin letters duplicated include U+212A K KELVIN SIGN and U+212B Å ANGSTROM SIGN. As in the case of the *ohm sign*, the corresponding regular Latin letters, are the canonical equivalents and therefore their use is preferred.

The *left* and *right angle brackets* at U+2328 and U+2329 have long been canonically equivalent with the CJK punctuation characters at U+3008 and U+3009, which implies that the use of the latter code points is preferred and that the characters are 'wide' characters. See [Unicode Standard Annex #11, "East Asian Width"](#) [EAW]. Unicode 3.2 added two new *mathematical angle bracket* characters (U+27E8 and U+27E9) that are unequivocally intended for mathematical use.

2.6 Accented Characters

Mathematical characters are often enhanced via use of combining marks in the ranges U+0300..U+036F and the combining marks for symbols in the range U+20D0..U+20FF. These characters follow the base characters as in non-mathematical Unicode text. This section discusses these characters and preferred ways of representing accented characters in mathematical expressions. If a span of characters is enhanced by a combining mark, *e.g.*, a tilde over AB, typically some kind of higher-level markup is needed as is done in [\[MathML\]](#). Unicode does include some combining marks that are designed to be used for pairs of characters, *e.g.*, U+0360..U+0362. However, their use for mathematical text is not encouraged.

For some mathematical characters there are multiple ways of expressing the character: as precomposed or as a sequence of base character and combining mark. It would be nice to have a single way to represent any given character, since this would simplify recognizing the character in searches and other manipulations. Selecting a unique representation among multiple equivalent representations is called normalization. [Unicode Standard Annex #15 "Unicode Normalization Forms"](#) [Normalization] discusses the subject in detail; however, due to requirements of non-mathematical software, the normalization forms presented there are not ideal from the perspective of mathematics.

Ideally, one always uses the shortest form of a math operator symbol wherever possible. So U+2260 should be used for the not equal sign instead of the combining sequence U+003D U+0338. This rule concurs with Normalization Form C (NFC) used on the web. If a negated operator is needed that does not have a precomposed form, the character U+0338 COMBINING LONG SOLIDUS OVERLAY can be used to indicate negation.

On the other hand, for accented *alphabetic* characters used as variables, ideally only decomposed sequences are used since there are no precomposed math alphanumerical symbols.

Mathematics uses a multitude of combining marks that greatly exceeds the predefined composed characters in Unicode. Accordingly, it is better to have the math display facility handle all of these cases uniformly to give a consistent look between characters that happen to have a fully composed Unicode character and those that do not. The combining character sequences also typically have semantics as a group, so it is handy to be able to manipulate and search for them individually without having to have special tables to decompose characters for this purpose. Note that this approach does not concur with Normalization Form C for the upright alphabetic characters (ASCII letters). To facilitate interchange on the web, accented characters should conform to NFC when interchanged.

However, to achieve consistent results, a mathematical display system should transiently decompose such letters when used in

mathematical expressions and use a single algorithm to place embellishments.

2.7 Operators

The Mathematical Operators (U+2200—U+22FF) and Supplementary Mathematical Operators (U+2A00—U+2AFF) blocks contain many mathematical operators, relations, geometric symbols and other symbols with special usages confined largely to mathematical contexts. In addition to the characters in these blocks, mathematical operators are also found in the Basic Latin (ASCII) and Latin-1 Supplement Blocks. A few of the symbols from the Miscellaneous Technical block and characters from General Punctuation are also used in mathematical notation. The allocation of any operator to a particular block is rarely significant.

Semantics. Mathematical operators often have more than one meaning in different subdisciplines or different contexts. For example, the "+" symbol normally denotes addition in a mathematical context, but might refer to concatenation in a computer science context dealing with strings, or incrementation, or have any number of other functions in given contexts. Therefore The Unicode Standard only encodes a single character for a single symbolic form. There are numerous other instances in which several semantic values can be attributed to the same Unicode value. For example, U+2218 RING OPERATOR may be the equivalent of *white small circle* or *composite function* or *apl jot*. The Unicode Standard does not attempt to distinguish all possible semantic values that may be applied to mathematical operators or relational symbols. It is up to the application or user to distinguish such meanings according to the appropriate context. Where information is available about the usage (or usages) of particular symbols, it has been indicated in the character annotations in Chapter 16, Code Charts in *The Unicode Standard, Version 4.0* [Unicode] and in the [online code charts](#) [Charts].

Similar glyphs. The Standard does include many characters that appear to be quite similar to one another, but that may well convey different meaning in a given context. On the other hand, mathematical operators, and especially relation symbols, may appear in various standards, handbooks, and fonts with a large number of purely graphical variants. Where variants were recognizable as such from the sources, they were not encoded separately.

For relation symbols, the choice of a vertical or forward-slanting stroke typically seems to be an aesthetic one, but both slants might appear in a given context. However, a back-slanted stroke almost always has a distinct meaning compared to the forward-slanted stroke. See [Section 2.17 "Variation Selector"](#) for more information on some particular variants.

Unifications. Mathematical operators such as *implies* and *if and only if* have been unified with the corresponding arrows (U+21D2 \Rightarrow RIGHTWARDS DOUBLE ARROW and U+2194 \leftrightarrow LEFT RIGHT ARROW, respectively) in the Arrows block.

The operator U+2208 ELEMENT OF is occasionally rendered with a taller shape than shown in the code charts. Mathematical handbooks and standards consulted treat these characters as variants of the same glyph. U+220A SMALL ELEMENT OF is a distinctively small version of the *element of* that originates in mathematical pi fonts.

The operators U+226B MUCH GREATER-THAN and U+226A MUCH LESS-THAN are sometimes rendered in a nested shape, but the Unicode Standard provides a single encoding for each operator.

A large class of unifications applies to variants of relation symbols involving equality, similarity, and/or negation. Variants involving one- or two-barred *equal signs*, one- or two-tilde *similarity signs*, and vertical or slanted *negation slashes* and *negation slashes* of different lengths are not separately encoded. Thus, for example, U+2288 NEITHER A SUBSET OF NOR EQUAL TO, is the archetype for at least six different glyph variants noted in various collections.

In two instances, essentially stylistic variants are separately encoded: U+2265 GREATER-THAN OR EQUAL TO is distinguished from U+2267 GREATER-THAN OVER EQUAL TO; the same distinction applies to U+2264 LESS-THAN OR EQUAL TO and U+2266 LESS-THAN OVER EQUAL TO. This exception to the general rule regarding variation results from requirements for character mapping to some Asian standards that distinguish the two forms.

Several mathematical operators derived from Greek characters have been given separate encodings since they are used differently than the corresponding letters. These operators may occasionally occur in context with Greek-letter variables. They include U+2206 INCREMENT, U+220F N-ARY PRODUCT, and U+2211 N-ARY SUMMATION. The latter two are large operators that take limits. Some typographical aspects of operators are discussed in [Section 3.2 "Classification by Typographical Behavior"](#). For example, the n-ary operators are distinguished from letter variables by their larger size and the fact that they take limit expressions.

The unary and binary minus sign is preferably represented by U+2212 MINUS SIGN rather than by the ASCII-derived U+002D HYPHEN-MINUS, both because the former is unambiguous and because it is rendered with a more desirable length. (For a complete list of dashes in the Unicode Standard, see *Table 6-2* in [\[TUS\]](#)).

Miscellaneous Symbols. U+22EE.. U+22F1 are a set of ellipses used in matrix notation.

2.8 Superscripts and Subscripts

The Unicode block U+2070.. U+209F plus U+00B2, U+00B3, and U+00B9 contain sequences of superscript and subscript digits and punctuation that can be useful in mathematics. If they are used, it is recommended that they be displayed with the same font size as other subscripts and superscripts at the corresponding nested script level. For example, a^2 and $a_{<super>2</super>}$ should be displayed the same. However, these subscript/superscript characters are not used in MathML or T_EX and their use with XML documents is discouraged, see [Unicode Technical Report #20, "Unicode in XML and other Markup Languages"](#) [\[UXML\]](#).

2.9 Arrows

Arrows are used for a variety of purposes in mathematics and elsewhere, such as to imply directional relation, to show logical derivation or implication, and to represent the cursor control keys. Accordingly Unicode includes a fairly extensive set of arrows (U+2190..U+21FF and U+2900..U+297F), many of which appear in mathematics. It does not attempt to encode every possible stylistic variant of arrows separately, especially where their use is mainly decorative. For most arrow variants, the Unicode Standard provides encodings in the two horizontal directions, often in the four cardinal directions. For the single and double arrows, the Unicode Standard provides encodings in eight directions.

Unifications. Arrows expressing mathematical relations have been encoded in the arrows block as well as in Supplemental Arrows-A and Supplemental Arrows-B. An example is U+21D2 RIGHTWARDS DOUBLE ARROW, which may be used to denote *implies*. Where available, such usage information is indicated in the annotations to individual characters in the Unicode Standard 4.0 [\[U4.0\]](#), Chapter 16, *Code Charts*, and in the [online code charts](#) [\[Charts\]](#).

Long Arrows. The long arrows encoded in the range U+27F5..U+27FF map to standard SGML entity sets supported by MathML. Long arrows represent distinct semantics from their short counterparts, rather than mere stylistic glyph differences. For example, the shorter forms of arrows are often used in connection with limits, whereas the longer ones are associated with mappings. The use of the long arrows is so common that they were assigned entity names in the ISOAMSA entity set, one of the suite of mathematical symbol entity sets covered by the Unicode Standard.

2.10 Delimiters

The mathematical white square brackets, angle brackets, and double angle brackets encoded at U+27E6..U+27EB are intended for ordinary mathematical use of these particular bracket types. They are unambiguously narrow, for use in mathematical and scientific notation, and should be distinguished from the corresponding wide forms of white square brackets, angle brackets, and double angle brackets used in CJK typography. (See the CJK Symbols and Punctuation block.)

Note especially that the "bra" and "ket" angle brackets, U+2329 LEFT-POINTING ANGLE BRACKET and U+232A RIGHT-POINTING ANGLE BRACKET, are now deprecated for use with mathematics because of their canonical equivalence to CJK angle brackets,

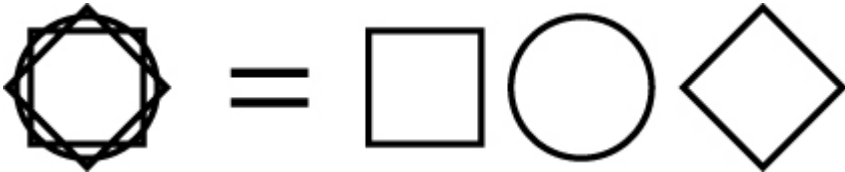
which is likely to result in unintended spacing problems when used in mathematical formulae.

However, the set of lenticular and tortoise-shell brackets in the CJK Punctuation block, as well as the white square brackets have not been duplicated and are intended for both CJK and mathematical use. For these characters, implementations for mathematical use need to use fonts without white space padding, i.e. containing the 'narrow' glyphs.

2.11 Geometrical Shapes

The basic geometric shapes (circle, square, triangle, diamond, and lozenge) are used for a variety of purposes in mathematical texts. Because their shapes are distinct and they are easily available in multiple sizes from a variety of widely available fonts, they are also often used in an ad-hoc manner.




















Ideal sizes. Mathematical usage requires at least four distinct sizes of simple shapes, and sometimes more. The size gradation must allow each size to be recognized, even when it occurs in isolation. In other words shapes of the same size should ideally have roughly the same visual "impact" as opposed to same nominal height or width. For mathematical usage simple shapes ideally share a common center. The following diagram shows which size relationship across shapes of the same nominal size is considered ideal.



Please note that neither the current set of glyphs in the standard nor the glyphs from many commonly available non-mathematical fonts achieves this ideal.

Actual sizes. The sizes of existing characters and their names are not always consistent. For mathematical usage, therefore, the MEDIUM SMALL SQUARE should be used together with the MEDIUM size of the other basic shapes, and correspondingly for the other sizes. (The basic shapes from the Zapf Dingbats font match the unmarked size for triangle, diamond and circle and the MEDIUM size for the square.) To achieve the correct size relation, mathematical fonts may need to deviate in minor amounts from the sizes shown in the character charts. The table below summarizes the available sizes for a given symbol.

Table 2.3 Existing sizes of simple shapes

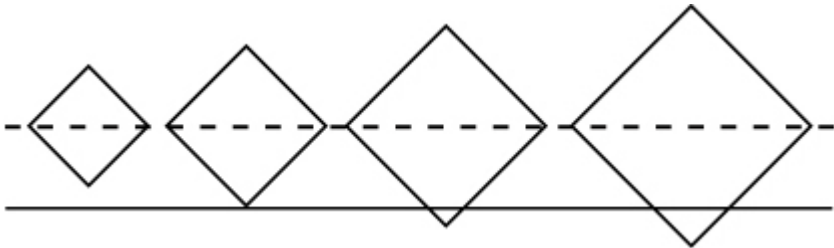
Size	Circles	Squares	Diamonds	Lozenges	Triangles
Large	 25EF	 2588			
Normal	 25CF	 25A0	 25C6	 /  29EB / 25CA	 25B2 etc.
Medium		 25FC			
Med. Small	 2981	 25FE			
Small	 /  2022 / 25E6	 25AA		 22C4	 25B4 etc.
Very Small	 /  /  2219 / 2218 / 00B7				

Tiny	•
	22C5

Most simple geometrical shapes exist in both black and outline (white) form in all sizes. Where these forms are not encoded under matching names or close together, separate images and code points are provided in the table. Triangles have size as well as direction. The Unicode Standard encodes the four principal directions.

Sizes of derived shapes. Circled and squared operators and similar derived shapes are more constrained in their usage than "plain" geometric shapes. They tend to occur in two generic sizes based on function: a smaller size for binary operators and large size for n-ary operators.

Positioning. For a mathematical font, the centerline should go through the middle of a parenthesis, which should go from bottom of descender to top of ascender. This is the same level as the minus or the middle of the plus and equal signs. For correct positioning, the glyph will descend below the baseline for the larger sizes of the basic shapes as in the following schematic diagram:



The standard triangles used for mathematics are also center aligned. This is different from the positioning for the reference glyphs of existing characters shown in the charts. Mathematical fonts may need to deviate in positioning of these triangles.

2.12 Other Symbols

Other symbols of use in mathematics are contained in the Miscellaneous Technical block (U+2300—U+23FF), the Geometric Shapes block (U+25A0—U+25FF), the Miscellaneous Symbols block (U+2600—U+267F), and the General Punctuation block (U+2000—U+206F).

Generally any easily recognized and distinct symbol is fair game for mathematicians faced with the need of creating notations for new fields of mathematics. For example, the card suits, U+2665 ♠ BLACK HEART SUIT, U+2666 ♡ BLACK SPADE SUIT, *etc.* can be found as operators and as subscripts.

2.13 Symbol Pieces

The characters from the Miscellaneous Technical block in the range U+239B—U+23B3, plus U+23B7, comprise a set of bracket and other symbol fragments for use in mathematical typesetting. These pieces originated in older font standards, but have been used in past mathematical processing as characters in their own right to make up extra-tall glyphs for enclosing multi-line mathematical formulae. Mathematical fences are ordinarily sized to the content that they enclose. However, in creating a large fence, the glyph is not scaled proportionally; in particular the displayed stem weights must remain compatible with the accompanying smaller characters. Thus, simple scaling of font outlines cannot be used to create tall brackets. Instead, a common technique is to build up the symbol from pieces. In particular, the characters U+239B LEFT PARENTHESIS UPPER HOOK through U+23B3 SUMMATION BOTTOM represent a set of glyph pieces for building up large versions of the fences (,), [,], {, and }, and of the large operators \sum and \int . These brace and operator pieces are compatibility characters. They should not be used in stored mathematical text, but are often used in the data stream created by display and print drivers.

The following table shows which pieces are intended to be used together to create specific symbols.

Table 2.4 Use of Symbol Pieces

	2-row	3-row	5-row
Summation	23B2, 23B3		
Integral	2320, 2321	2320, 23AE, 2321	2320, 3×23AE, 2321
Left Parenthesis	239B, 239D	239B, 239D	239B, 3×239C, 239D
Right Parenthesis	239E, 23A0	239E, 239F, 23A0	239E, 3×239F, 23A0
Left Bracket	23A1, 23A3	23A1, 23A2, 23A4	23A1, 3×23A2, 23A3
Right Bracket	23A4, 23A6	23A4, 23A5, 23A6	23A4, 3×23A5, 23A6
Left Brace	23B0, 23B1	23A7, 23A8, 2389	23A7, 23AA, 23A8, 23AA, 2389
Right Brace	23B1, 23B0	23AB, 23AC, 23AD	23AB, 23AA, 23AC, 23AA, 23AD

For example, an instance of U+239B can be positioned relative to instances of U+239C and U+239D to form an extra-tall (three or more line) left-parenthesis. The center sections encoded here are meant to be used only with the top and bottom pieces encoded adjacent to them, since the segments are usually graphically constructed within the fonts so that they match perfectly when positioned at the same *x* coordinates.

2.14 Invisible Operators

In mathematics some operators or punctuation are often implied, but not displayed. U+2063 INVISIBLE SEPARATOR or *invisible comma* is intended for use in index expressions and other mathematical notation where two adjacent variables form a list and are not implicitly multiplied. In mathematical notation, commas are not always explicitly present, but need to be indicated for symbolic calculation software to help it disambiguate a sequence from a multiplication. For example, the double *ij* subscript in the variable *a_{ij}* means *a_{i,j}* — that is, the *i* and *j* are separate indices and not a single variable with the name *ij* or even the product of *i* and *j*. Accordingly to represent the implied list separation in the subscript *ij* one can insert a non-displaying *invisible separator* between the *i* and the *j*. In addition, use of the invisible comma would hint to a math layout program to set a small space between the variables.

Similarly an expression like *mc²* implies that the mass *m* multiplies the square of the speed *c*. To unambiguously represent the implied multiplication in *mc²*, one inserts a non-displaying U+2062 INVISIBLE TIMES between the *m* and the *c*. A related case is the use of U+2061 FUNCTION APPLICATION for an implied function dependence as in *f_(x+y)*. To indicate that this is the function *f* of the quantity *x+y* and not the expression *fx + fy*, one can insert the non-displaying *function application symbol* between the *f* and the left parenthesis.

Another example is the expression *f^{ij}(cos(ab))*, which means the same as *f^{ij}(cos(a×b))*, where *×* represents *multiplication*, not the *cross product*. Note that the spacing between characters may also depend on whether the adjacent variables are part of a list or are to be concatenated, that is, multiplied.

2.15 Other Characters

These include all remaining Unicode characters. They may appear in mathematical expressions, typically in spelled-out names for variables in fractions or simple formulae, but they most commonly appear in ordinary text. An English example is the equation

distance = rate × time,















































which uses ordinary ASCII letters to aid in recognizing sequences of letters as words instead of products of individual symbols. Such usage corresponds to identifiers, discussed elsewhere.

2.16 Negations

Many negated forms, particularly of relations, can be encoded by using the base symbol, together with a combining overlay. Occasionally, both a vertical and a slanted negation are used; which one is often a matter of style. Sometimes the negation is only indicated for part of a symbol. In these cases, the negated relations are encoded directly, and variants can be accessed via the *variation selector* method described in the next section.

The following table lists variants of negated mathematical symbols that can be realized via composition, by using U+20D2 COMBINING LONG VERTICAL LINE OVERLAY for negation instead of the slanted U+0338 COMBINING LONG SOLIDUS OVERLAY. This contrasts to the use of U+FE00 VARIATION SELECTOR-1 for those symbols for which only a partial vertical stroke is used, and for which the use of U+20D2 would not give the intended result. The part of the description in SMALL CAPS is the character name of the corresponding standard character; the part in lower case indicates the variation in appearance.





































Table 2.5 Negated relations using vertical line overlay

Std Symbol	Alternate Symbol	Description of alternate symbol
 2209	 2208,20D2	NOT AN ELEMENT OF with vertical stroke
 220C	 220B,20D2	DOES NOT CONTAIN AS MEMBER with vertical stroke
 2241	 223C,20D2	NOT TILDE with vertical stroke
 2244	 2243,20D2	NOT ASYMPTOTICALLY EQUAL TO with vertical stroke
 2247	 2245,20D2	NEITHER APPROXIMATELY NOR ACTUALLY EQUAL TO with vertical stroke
 2249	 2248,20D2	NOT ALMOST EQUAL TO with vertical stroke
 2260	 003D,20D2	NOT EQUAL TO with vertical stroke
 2262	 2261,20D2	NOT IDENTICAL TO with vertical stroke
 226D	 224D,20D2	NOT EQUIVALENT TO with vertical stroke
 226E	 003C,20D2	NOT LESS-THAN with vertical stroke
 226F	 003E,20D2	NOT GREATER-THAN with vertical stroke
 2270	 2264,20D2	NEITHER LESS-THAN NOR EQUAL TO with vertical stroke
 2271	 2265,20D2	NEITHER GREATER-THAN NOR EQUAL TO with vertical stroke
 2278	 2278, 20D2	NEITHER LESS-THAN NOR GREATER-THAN with vertical stroke (*)
 2279	 2279, 20D2	NEITHER GREATER-THAN NOR LESS-THAN with vertical stroke (*)
 2280	 227A,20D2	DOES NOT PRECEDE with vertical stroke
 2281	 227B,20D2	DOES NOT SUCCEED with vertical stroke
 2284	 2282,20D2	NOT A SUBSET OF with vertical stroke
 2285	 2283,20D2	NOT A SUPERSET OF with vertical stroke
 2288	 2286,20D2	NEITHER A SUBSET OF NOR EQUAL TO with vertical stroke
 2289	 2287,20D2	NEITHER A SUPERSET OF NOR EQUAL TO with vertical stroke
 22E0	 227C,20D2	DOES NOT PRECEDE OR EQUAL with vertical stroke
 22E1	 227D,20D2	DOES NOT SUCCEED OR EQUAL with vertical stroke

* The reference glyphs shown in the code charts [Charts] have been revised in Unicode 4.0 to show the slanted forms – this matches their existing decomposition using U+0338 COMBINING LONG SOLIDUS OVERLAY (see Section 2.32, Reference Glyphs for 2278 and 2279 for more information).

The following table lists some of the negated forms of mathematical relations that can *only* be encoded by using either U+0338 COMBINING LONG SOLIDUS OVERLAY or U+20D2 COMBINING LONG VERTICAL LINE OVERLAY. Depending on the overlay used, the negation has a diagonal or vertical stroke. The part of the description that is in SMALL CAPS reflects the Unicode character name of the non-negated symbol. Since these are not glyph variants of existing characters, the word "negated" is used instead of "NOT" as in the list above, to indicate that the negation is expressed by the combining character sequence, and not inherent in the character.

Table 2.6 Using vertical line or solidus overlay

Glyph / Sequence	Glyph / Sequence	Description
 220A,0338	 220A,20D2	negated SMALL ELEMENT OF
 220D,0338	 220D,20D2	negated SMALL CONTAINS AS MEMBER
 2242,0338	 2242,20D2	negated MINUS TILDE
 2263,0338	 2263,20D2	negated STRICTLY EQUIVALENT TO
 2266,0338	 2266,20D2	negated LESS-THAN OVER EQUAL TO
 2267,0338	 2267,20D2	negated GREATER-THAN OVER EQUAL TO
 22F7,0338	 22F7,20D2	negated ELEMENT OF WITH OVERBAR
 22FE,0338	 22FE,20D2	negated SMALL CONTAINS WITH OVERBAR
 2A6C,20D2	 2A6C,0338	negated SIMILAR MINUS SIMILAR
 2A70,0338	 2A70,20D2	negated APPROXIMATELY EQUAL OR EQUAL TO
 2A7D,0338	 2A7D,20D2	negated LESS-THAN OR SLANTED EQUAL TO
 2A7E,0338	 2A7E,20D2	negated GREATER-THAN OR SLANTED EQUAL TO
 2A95,0338	 2A95,20D2	negated SLANTED EQUAL TO OR LESS-THAN
 2A96,0338	 2A96,20D2	negated SLANTED EQUAL TO OR GREATER-THAN
 2A99,0338	 2A99,20D2	negated DOUBLE-LINE EQUAL TO OR LESS-THAN
 2A9A,0338	 2A9A,20D2	negated DOUBLE-LINE EQUAL TO OR GREATER-THAN
 2AC5,0338	 2AC5,20D2	negated SUBSET OF ABOVE EQUALS SIGN
 2AC6,0338	 2AC6,20D2	negated SUPERSET OF ABOVE EQUALS SIGN

Note that in some cases, as seen in the two preceding tables, simply using the generic glyph for the *vertical overlay* will not give the correct appearance. 2286 or 2A99 are examples of characters that may require a taller stroke. Similarly, the position of the *solidus overlay* shown for 2AC6 above is not ideal.

2.17 Variation Selector

The variation selector VS1 is used to represent well-defined variants of particular math symbols. The variations include: different slope of the cancellation element in some negated symbols, changed orientation of an equating or tilde operator element, and some well-defined different shapes. These mathematical variants are all produced with the addition of U+FE00 VARIATION SELECTOR 1 (VS1) to mathematical operator base characters. To select one of the predefined variations, follow the base character with the variation selector.

The following table lists only those of the currently defined combinations combinations that are of interest in the context of mathematics. In the table, the part of the description in SMALL CAPS is the character name of the corresponding standard character; the part in lower case indicates the variation in appearance. The full set of valid, recognized combinations is listed in the table of standardized variants: [\[StdVar\]](#) in the Unicode Character Database. All combinations not listed there are unspecified and are reserved for future standardization; no conformant process may interpret them as standardized variants. For more information, see [Section 15.9, Variation Selectors](#), in Unicode 4.0 [U4.0].

Table 2.7 Variants of Mathematical Symbols using VS1

Sequence	Description
2229 + VS1	INTERSECTION with serifs
222A + VS1	UNION with serifs
2268 + VS1	LESS-THAN BUT NOT EQUAL TO – with vertical stroke
2269 + VS1	GREATER-THAN BUT NOT EQUAL TO – with vertical stroke
2272 + VS1	LESS-THAN OR EQUIVALENT TO – following the slant of the lower leg
2273 + VS1	GREATER-THAN OR EQUIVALENT TO – following the slant of the lower leg
228A + VS1	SUBSET OF WITH NOT EQUAL TO – variant with stroke through bottom members

228B + VS1	SUPERSET OF WITH NOT EQUAL TO – variant with stroke through bottom members
2293 + VS1	SQUARE CAP with serifs
2294 + VS1	SQUARE CUP with serifs
2295 + VS1	CIRCLED PLUS with white rim
2297 + VS1	CIRCLED TIMES with white rim
229C + VS1	CIRCLED EQUALS – equal sign inside and touching the circle
22DA + VS1	LESS-THAN slanted EQUAL TO OR GREATER-THAN
22DB + VS1	GREATER-THAN slanted EQUAL TO OR LESS-THAN
2A3C + VS1	INTERIOR PRODUCT – tall variant with narrow foot
2A3D + VS1	RIGHTHAND INTERIOR PRODUCT – tall variant with narrow foot
2A9D + VS1	SIMILAR OR LESS-THAN – following the slant of the upper leg – or less-than
2A9E + VS1	SIMILAR OR GREATER-THAN – following the slant of the upper leg – or greater-than
2AAC + VS1	SMALLER THAN OR slanted EQUAL
2AAD + VS1	LARGER THAN OR slanted EQUAL
2ACB + VS1	SUBSET OF ABOVE NOT EQUAL TO – variant with stroke through bottom members
2ACC + VS1	SUPERSET OF ABOVE NOT EQUAL TO – variant with stroke through bottom members

Using a variation selector allows users and font designers to make a distinction between alternate glyph shapes *both* of which are ordinarily acceptable glyphs for generic, non-distinguishing usage of the standalone character code. This situation is somewhat analogous to the variants of Greek letterforms, which are not distinguished when used in text, but must be distinguished when used as symbols. See Section 2.31, "Reference Glyphs for Greek phi". However, unlike the Greek symbols, which are encoded using distinct character codes, the Unicode Standard considers the distinctions expressed via the variation selector as somewhat optional. Processes or fonts that cannot support it should yield acceptable results by ignoring the variation selector.

It is important to further note that the variation selector only selects a different *appearance* of an already encoded character. It is not intended as a general code extension mechanism. At this time the variations encoded with the variation selector are thought to be primarily glyphic variations. Should their usage or interpretation change—over time, or because of better evidence about how these shapes are actually used in mathematical notation—it is likely that another character would be coded so that the distinction in meaning can be kept directly in the character code.

2.18 Novel Symbols not yet in Unicode

Mathematicians are by their nature inventive people and will continue to invent new symbols to express their concepts. Until these symbols are used by a considerable number of people, they should not be standardized. Nevertheless, one needs a way to handle these novel symbols even before they are standardized.

The Private Use Areas (U+E000—U+F8FF, U+F0000—U+FFFFD, and U+100000—U+10FFFFD) can be used for such nonstandard symbols. However, that can be a tricky business, since the Private Use Area (PUA) is used for many purposes. Hence when using the PUA, it is a good idea to have higher-level backup to define what kind of characters are involved. If they are used as math symbols, it would be good to assign them a math attribute that is maintained in a rich-text layer parallel to the plain text.

Markup languages also may have other ways of using arbitrary glyphs as 'pseudo-characters'; for instance, MathML [MathML] has an `mglyph` element.

3 Mathematical Character Properties

Unicode assigns a number of mathematical character properties to aid in the default interpretation and rendering of these characters. Such properties include the classification of characters into operator, digit, delimiter, and variable. These properties may be overridden, or explicitly specified in some environments, such as MathML [MathML], which uses specific tags to indicate how Unicode characters are used, such as `<mo>` for operator, `<mn>` for one or more digits comprising a number, and `<mi>`

for identifier. \TeX , \TeX is a higher-level composition system that uses implicit character semantics. In the following, these properties are described in greater detail.

In particular, many Unicode characters nearly always appear in mathematical expressions and are given the generic mathematics property \Math . Among others, they include the math operators in the ranges U+2200..U+22FF and U+29B0..U+2AFF , the math combining marks U+20D0..U+20FF , the math alphanumeric characters (some of the Letterlike Symbols and the mathematics alphanumerics range U+1D400..U+1D7FF). Other characters may occur in mathematical usage depending on context. The math useful in heuristics that seek to identify mathematical expressions in plain text.

For more information about character properties, see the forthcoming Unicode Character Property Model \PropMod .

3.1 Classification by degree of Mathematical Usage

Each character in the Unicode Standard is given a General Category. This is one of a set of values that represent a primary feature or function of a character. Characters that are primarily used as mathematical symbols and operators are given the General Category (gc) value of symbol_math (sm). However, other characters commonly or exclusively used in mathematics, are classified first and foremost by their function as delimiting punctuation, rather than as math symbols. This affects in particular many of the math delimiters. The math property, which is designed to be applied to all characters used commonly with mathematical notation is therefore a superset of the characters with $\text{gc} = \text{sm}$. The difference between the sets of characters that have the math property and those for which $\text{gc} = \text{sm}$, is given by the set of characters that have the other_math property.

3.1.1 Strongly Mathematical Characters

Strong mathematical characters are all characters that are primarily used for mathematical notation. This includes all characters with the math property in Unicode 4.0 \U4.0 , with the following exceptions:

Code	Description
0028..0029	ASCII Parentheses
002A	ASTERISK
002D	HYPHEN-MINUS
002F	SOLIDUS
005B,005D	Square brackets
005C	Backslash
006E	CIRCUMFLEX ACCENT
007B,007D	Curly brackets
007C	Vertical Bar
007E	TILDE
FE35..FE38	Vertical parens and brackets
FE47..FE48	..
FE59..FE5C	CJK small form of parens and brackets
FF28..0029	FULLWIDTH Parentheses
FF2A	FULLWIDTH ASTERISK
FF2D	FULLWIDTH HYPHEN-MINUS
FF2F	FULLWIDTH SOLIDUS
FF5B,005D	FULLWIDTH Square brackets
FF5C	FULLWIDTH Backslash
FF6E	FULLWIDTH CIRCUMFLEX ACCENT
FF7B,FF7D	FULLWIDTH Curly brackets
FF7C	FULLWIDTH Vertical Bar

FF7E FULLWIDTH TILDE
 FFE9..FFEC Halfwidth arrows

and the following additions:

Code	Description
03D0..03D2	Greek symbols for math and technical use
03D5	..
03F0..03F1	..
03F4..03F6	..
2040	used in z notation
2061..2063	Invisible math operators
20E5..20E6	Overlays
2129	A logic symbol
213D..213F	Double-struck Greek
2145..2149	Double-struck italic
23B7	RADICAL SYMBOL BOTTOM
23AF	HORIZONTAL LINE EXTENSION
23D0	VERTICAL LINE EXTENSION
27E6..27EE	Math brackets
2983..2998	..
29D8..29DB	Fences
29FC..29FD	Curly angle brackets

[ED: The precise details of the above two lists are expected to change somewhat as result of the review of the math property in the UTC. The final document will track any changes made in the UTC.]

Despite their classification as strongly mathematical characters, many characters can also occur in non-mathematical texts, and the concept of mathematical use is deliberately kept broad.

3.1.2 Weakly Mathematical Characters

These characters often appear in mathematical expressions, but they also appear naturally in ordinary text. They include the ASCII letters, punctuation, as well as the arrows and many of the geometric and technical shapes. The ASCII hyphen minus (U+002D) is a weakly mathematical character that may be used for the subtraction operator, but U+2212 is preferred for this purpose and looks better. Geometric shapes are frequently used as mathematical operators, but have other uses as well.

These consist of the following characters:

Code	Description
0021	Exclamation mark (factorial)
0028..0029	ASCII Parentheses
002A	ASTERISK
002C	SOLIDUS
002D	HYPHEN-MINUS
002E	FULL STOP
0030..0039	Digits
0041..005A	Letters

006E	CIRCUMFLEX ACCENT
005B,005D	Square brackets
005C	Backslash
007B,007D	Curly brackets
007E	TILDE
0061..007A	..
3010..3011	CJK brackets unified with Math use
3014..3019	..

[ED: These arrows that don't have the math property in 4.0 should probably be added to this set as proposed in the next section of this table—but 21EA..21F3 should be excepted as they are specifically keyboard symbols:]

2195..2199	Arrows
219C..219F	..
21A1..21A2	..
21A4..21A5	..
21A7..21AD	..
21B0..21CD	..
21D0..21D1	..
21D3	..
21D5..21E9	..
21EA..21F3	..
2B00..2B0D	..

[ED: the following characters have the math property in 4.0. That should probably also make them weak math characters:]

FE35..FE38	Vertical parens and brackets
FE47..FE48	..
FE59..FE5C	CJK small form of parens and brackets
FF0D	FULLWIDTH HYPHEN-MINUS
FF0F	FULLWIDTH SOLIDUS
FF08..FF09	FULLWIDTH Parentheses
FF4E	FULLWIDTH CIRCUMFLEX ACCENT
FF3B,FF3D	FULLWIDTH Square brackets
FF3C	FULLWIDTH Backslash
FF5B,FF5D	FULLWIDTH Curly brackets
FF5C	FULLWIDTH Vertical Bar
FF5E	FULLWIDTH TILDE
FFE9..FFEC	Halfwidth arrows

[ED: The precise details of the above table are subject to changes as result of the review of the math property. In addition, if review shows that math use of some specific arrows is really uncommon, they can be excluded again.]

3.1.3 Other

All other Unicode characters. Many of these may occur in mathematical texts, though not often as part of the mathematical expressions themselves.

3.2 Classification by Typographical Behavior

Math characters fall into a number of subcategories, such as operators, digits, delimiters, and identifiers (constants and variables). This section discusses some of the typographical characteristics of these subcategories. These characteristics and classifications are useful in the absence of overriding information. For example, there is at least one document that uses the letter *P*, in upright roman typestyle, as a relational operator.

3.2.1 Alphabetic

In general italic Latin characters are used to represent single-character Latin variables. In contrast, mathematical function names like *sin*, *cos*, *tan*, *tanh*, *etc.*, are represented by upright serified text to distinguish them from products of variables. Such names should not use the math alphanumeric characters. The upright uppercase Greek are favored over the italic ones. In Europe, upright *d*, *D*, *e*, and *i* can be used today for the two differential, exponential, and imaginary part functionalities, respectively. In common American mathematical practice, these quantities are represented by italic quantities. Products of italicized variables have slightly wider spacing than the letters in italicized words in ordinary text.

3.2.2 Operators

Operators fall into one or more categories. These include:

Table 3.1 Some Operator Categories

Category	Notes
binary	some spacing around binary operators
unary	closer to modified character than binary operators
n-ary	often called "large" operators, take limits ordinarily above and below when displayed out-of-line or right top and bottom when displayed in-line
arithmetic	arithmetic includes binary and unary operators
logical	unary not and binary and, or, exclusive or in a host of guises
set-	inclusion, exclusion, in a variety of guises
theoretic	
relational	binary operators like less/greater than in many forms

As in arithmetic, operators have precedence, which streamlines the interpretation of operands and reduces the notational complexity of expressions. Operator precedence is commonly used for this purpose in computer programming languages, calculus, and algebra. Assigning consistent default precedence to the operators allows software to automate the transition from data input (or plain text) to fully marked up forms of mathematical data such as TeX or MATHML.

For example, in arithmetic, $3 + 1/2 = 3.5$, not 2. Similarly the plain-text expression $\alpha + \beta/\gamma$ means

$$\alpha + \frac{\beta}{\gamma} \text{ not } \frac{\alpha + \beta}{\gamma} .$$

As in arithmetic, precedence can be overruled by explicit delimitation, so $(\alpha + \beta)/\gamma$ gives the latter.

3.2.3 Large Operators

These include n-ary operators like summation and integration. These may expand in size to fit their associated expressions. They generally also take limits. The placement of the limits on an operator is different when it is used in-line compared to its

use in displayed formulae. For example $\sum_{n=1}^{\infty} a_n$ versus

$$\sum_{n=1}^{\infty} a_n .$$

Specifying a particular layout for limit expressions is outside the scope of the Unicode Standard.

3.2.4 Digits

Digits include 0–9 in various styles. All digits of a particular style have the same width.

3.2.5 Delimiters

Delimiters include punctuation, opening/closing delimiters such as parentheses and brackets, braces, and fences. Opening and closing delimiters and fences may expand in size to fit their associated expressions. Some bracket expressions do not appear to be "logical" to readers unfamiliar with the notation, e.g., $]_{x,y}[$.

3.2.6 Fences

Fences are similar to opening and closing delimiters, but are not paired.

3.2.7 Combining Marks

Combining marks are used with mathematical alphabetic characters (see [Section 2.6 "Accented Characters"](#)), instead of precomposed characters. Use `<U+0061, U+0308>` for the second derivative of acceleration with respect to time, not the precomposed letter ä. On the other hand, precomposed characters are used for operators whenever they exist. Combining slash (solidus) or vertical overlays can be used to indicate negation for operators that do not have precomposed negated forms.

Where both long and short combining marks exist, use the long, e.g., use U+0338, not U+0337 COMBINING SHORT OVERLAY and use U+20D2, not U+20D3 COMBINING SHORT VERTICAL LINE OVERLAY. The actual shape or position of a combining mark is a typesetting problem and not specified in plain text. When using combining marks, the composite characters have the same typesetting class as the base character.

4 Implementation Guidelines

4.1 Use of Normalization with Mathematical Text

If Normalization Form C is applied to mathematical text, some accents or overlays used with BMP alphabetic characters may be composed with their base character, even though for mathematical text the decomposed forms would have been preferred. Parsers should allow for this. Normalization forms KC or KD remove the distinction between different mathematical alphabets. These forms *cannot* be used with mathematical texts. For more details on Normalization see [Unicode Standard Annex #15, "Unicode Normalization Forms"](#) [[Normalization](#)] and the discussion in [Section 2.6 "Accented Characters"](#).

4.2 Input of Mathematical and Other Unicode Characters

In view of the large number of characters used in mathematics, it is useful to give some discussion of input methods. The ASCII math symbols are easy to find, e.g., `+ - / * [] () { }`, but often need to be used as themselves.

Post-entry correction. From a syntactical point of view, the official Unicode minus sign (U+2212) is certainly preferable to the

ASCII hyphen-minus (U+002D) and the prime (U+2032) is preferable to the ASCII apostrophe (U+0027), but users may locate the ASCII characters more easily. Similarly it is easier to type ASCII letters than italic letters, but when used as mathematical variables, such letters are traditionally italicized in print. Accordingly a user might want to make italic the default alphabet in a math context, reserving the right to overrule this default when necessary. Other post-entry enhancements include automatic-ligature and left-right quote substitutions, which can be done automatically by some word processors. Suffice it to say that intelligent input algorithms can dramatically simplify the entry of mathematical symbols.

Math keyboards. A special math shift facility for keyboard entry could bring up proper math symbols. The values chosen can be displayed on an *on-screen keyboard*. For example, the left Alt key could access the most common mathematical characters and Greek letters, the right Alt key could access italic characters plus a variety of arrows, and the right Ctrl key could access script characters and other mathematical symbols. The numeric keypad offers locations for a variety of symbols, such as sub/superscript digits using the left Alt key. Left Alt CapsLock could lock into the left-Alt symbol set, etc. This approach yields what one might call a "sticky" shift. Other possibilities involve the NumLock and ScrollLock keys in combinations with the left/right Ctrl/Alt keys. Pretty soon one realizes that this approach rapidly approaches literally billions of combinations, that is, several orders of magnitude more than Unicode can handle!

Macros. The auto-correct and keyboard macro features of some word processing systems provide other ways of entering mathematical characters for people familiar with TeX. For example, typing \alpha inserts α if the appropriate auto-correct entry is present. This approach is noticeably faster than using menus.

Hexadecimal input. A handy hex-to-Unicode entry method works with recent Microsoft text software (similar approaches are available on other systems) to insert Unicode characters in general and math characters in particular. Basically one types a character's hexadecimal code (in ASCII), making corrections as need be, and then types Alt+x. The hexadecimal code is replaced by the corresponding Unicode character. The Alt+x can be a toggle, that is, type it once to convert a hex code to a character and type it again to convert the character back to a hex code. If the hex code is preceded by one or more hexadecimal digits, one needs to "select" the code so that the preceding hexadecimal characters aren't included in the code. The code can range up to the value 0x10FFFF, which is the highest character in the 17 planes of Unicode.

Pull-down menus. Pull-down menus are a popular method for handling large character sets, but they are slow. A better approach is the *symbol box*, which is an array of symbols either chosen by the user or displaying the characters in a font. Symbols in symbol boxes can be dragged and dropped onto key combinations on the on-screen keyboard(s), or directly into applications. On-screen keyboards and symbol boxes are valuable for entry of mathematical expressions and of Unicode text in general.

Unicode plain-text mathematics. One use of the plain-text format is as a math input method, both for search text and for general editing.

4.3 Use of Math Characters in Computer Programs

It can be very useful to have typical mathematical symbols available in computer programs. To realize the full potential of supporting mathematical symbols as part of identifiers, a development environment should display the desired characters in both edit and debug windows. A preprocessor can translate MathML, for example, into C++, but it will not be able to make the debug windows use the math-oriented characters since the language cannot handle the underlying Unicode characters. Java has made an important step in this direction by allowing Unicode in identifiers. The mathematical alphanumeric symbols make this approach quite powerful for the user with relatively little effort for compilers.

The advantages of using Unicode characters directly in computer program identifiers are at least threefold:

1. Many formulas in document files can be programmed simply by copying them into a program file and inserting appropriate multiplication dots. This dramatically reduces coding time and errors.
2. The use of the same notation in programs and the associated journal articles and books leads to an unprecedented level

of self-documentation.

3. In addition to providing useful tools for the present, these proposed initial steps ease the way towards the ultimate goal of teaching computers to understand and use arbitrary mathematical expressions.

4.4 Recognizing Mathematical Expressions

It is possible to use a number of heuristics for identifying mathematical expressions and treating them accordingly, for example to tag expressions input as plain text with a rich-text math style. Such heuristics are not foolproof, but they lead to the most popular choices. Ultimately the approach could be used in post-entry correction. The user could then override cases that were tagged incorrectly. A math style would connect in a straightforward way to appropriate MathML tags.

The basic idea is that math characters identify themselves as such *and* potentially identify their surrounding characters as math characters as well. For example, the fraction (U+2044) and ASCII slashes, symbols in the range U+2200 through U+22FF, the symbol combining marks (U+20D0..U+20FF), and in general, Unicode characters with the mathematics property, identify the characters immediately surrounding them as parts of math expressions.

If English letter mathematical variables are already given in one of the math alphabets, they are considered parts of math expressions. If they are not, one can still have some recognition heuristics as well as the opportunity to italicize appropriate variables. Specifically ASCII letter pairs surrounded by whitespace are often mathematical expressions, and as such should be converted to using math italics. If a letter pair fails to appear in a list of common English and European two-letter words, it is treated as a mathematical expression and converted to italics. Many Unicode characters are not mathematical in nature and suggest that their neighbors are not parts of mathematical expressions.

Strings of characters containing no white space but containing one or more unambiguous mathematical characters are generally treated as mathematical expressions. Certain two-, three-, and four-letter words inside such expressions should *not* use italics. These include trigonometric function names like sin and cos, as well as ln, cosh, etc. Words or abbreviations that are often used as subscripts, also should not be italicized, even when they clearly appear inside mathematical expressions.

4.5 Some Examples of Mathematical Notation

This section gives some additional, but still relatively straightforward examples of mathematical notation for the benefit of readers not familiar with it. The simple built-up fraction

$$\frac{abc}{d}$$

appears in inline text as $(abc)/d$; similarly the inline text $(a+c)/d$ could appear as

$$\frac{a + c}{d}$$

in display. For the ratio

$$\frac{\alpha_2^3}{\beta_2^3 + \gamma_2^3},$$

an inline format is $\alpha_2^3/(\beta_2^3+\delta_2^3)$. In equations such as

$$W_{\delta_1\rho_1\sigma_2}^{3\beta}=U_{\delta_1\rho_1}^{3\beta}+\frac{1}{8\pi^2}\int\limits_{\alpha_1}^{\alpha_2}d\alpha_2'\left[\frac{U_{\delta_1\rho_1}^{2\beta}-\alpha_2'U_{\rho_1\sigma_2}^{1\beta}}{U_{\rho_1\sigma_2}^{0\beta}}\right]$$

the size of the integral or bracket scales with the size of the enclosed text. This example also shows the positioning of multiple sub- and superscripts as well as the positioning of limit expressions on the integral.

Punctuation following math in display is commonly on the local baseline or centerline.

5 Mathematical classification

The data file [Data] provides a classification of characters by primary usage in mathematical notation. The classes used in this file are defined as follows:

Table A-1 Classes of Mathematical Characters

Class	Name	Comments
N	Normal	This includes all the digits and symbols requiring only one form
A	Alphabetic	
B	Binary	
C	Close	Paired with opening delimiter
D	Diacritic	
F	Fence	Unpaired delimiter
O	Open	Paired with closing delimiter
L	Large	N-Ary or Large operator, often takes limits
P	Punctuation	
R	Relation	Includes arrows

The same file also contains mappings to standard entity sets commonly used for SGML and MathML documents.

[Ed.: For the review, the data table is attached at the end of this document, even though it is normally a separate file.]

6 Conformance

In the context of the Unicode Standard, the material in this technical report is *informative*. However, other documents may specify conformance including normative references to this document.

References

[Charts]

The online code charts can be found at <http://www.unicode.org/charts/> An index to characters names with links to the corresponding chart is found at <http://www.unicode.org/charts/charindex.html>

[Data]	Classification of math characters by usage: MathClass-6.txt
[EAW]	Unicode Standard Annex #11, <i>East Asian Width</i> . http://www.unicode.org/unicode/reports/tr11 <i>For a definition of East Asian Width</i>
[FAQ]	Unicode Frequently Asked Questions http://www.unicode.org/unicode/faq/ <i>For answers to common questions on technical issues.</i>
[Glossary]	Unicode Glossary http://www.unicode.org/glossary/ <i>For explanations of terminology used in this and other documents.</i>
[LaTeX]	<i>LaTeX: A Document Preparation System, User's Guide & Reference Manual</i> , 2nd edition, by Leslie Lamport (Addison-Wesley, 1994; ISBN 1-201-52983-1)
[Math]	Math Property in the Unicode Character Database. For more information see http://www.unicode.org/Public/UNIDATA/ucd.html#Math
[MathML]	<i>Mathematical Markup Language (MathML™) 2.0 Specification</i> . (W3C Recommendation, revision of 21 February 2001) Editors: David Carlisle, Patrick Ion, Robert Miner and Nico Poppelier. http://www.w3.org/TR/MathML2/ <i>Slated to go into a second edition at the time of this writing.</i>
[Meystre]	P. Meystre and M. Sargent III (1991), <i>Elements of Quantum Optics</i> , Springer-Verlag
[Normalization]	Unicode Standard Annex #15: <i>Unicode Normalization Forms</i> http://www.unicode.org/unicode/reports/tr15/
[OpenMath]	<i>The OpenMath Standard, 1.0</i> http://www.openmath.org/cocoon/openmath/standard/opmstd.pdf
[PropMod]	Unicode Technical Report #23: <i>The Unicode Character Property Model</i> , http://www.unicode.org/reports/tr23/
[Reports]	Unicode Technical Reports http://www.unicode.org/unicode/reports/ <i>For information on the status and development process for technical reports, and for a list of technical reports.</i>
[SI]	International System of Units (SI) – <i>Le Système International d'Unités</i> . The metric system of weights and measures based on the meter, kilogram, second and ampere, Kelvin and candela. <i>For background information see</i> http://physics.nist.gov/cuu/Units/index.html .
[StdVar]	For the formal list of Standardized Variants in the Unicode Character Database, see: http://www.unicode.org/Public/UNIDATA/StandardizedVariants.html or http://www.unicode.org/Public/UNIDATA/StandardizedVariants.txt
[STIX]	STIX Project Home Page: http://www.ams.org/STIX
[TeX]	Donald E. Knuth, <i>The T_EXbook</i> , (Reading, Massachusetts: Addison-Wesley 1984)

The T_EXbook is the manual for Donald Knuth's T_EX composition system. Appendix G describes the somewhat idiosyncratic mechanism used by T_EX to accomplish the composition of mathematical notation; it is based on the principles laid out in [Chaundy, Wick, Swanson], as well as on examination of a large number of published samples that demonstrated Knuth's style preferences.

Donald E. Knuth, *T_EX, the Program*, Volume B of *Computers & Typesetting*, (Reading, Massachusetts: Addison-Wesley 1986)

See also <http://www.ams.org/tex/publications.html>

- [U3.0] *The Unicode Standard, Version 3.0*, (Reading, MA, Addison-Wesley, 2000. ISBN 0-201-61633-5) or online as <http://www.unicode.org/unicode/uni2book/u2.html>
- [U3.1] Unicode Standard Annex #27: *Unicode 3.1*
<http://www.unicode.org/unicode/reports/tr27/>
- [U3.2] Unicode Standard Annex #28: *Unicode 3.2*
<http://www.unicode.org/unicode/reports/tr28/>
- [U4.0] *The Unicode Standard, Version 4.0*, (Reading, MA, Addison-Wesley, 2003. ISBN 0-321-18578-1) or online as <http://www.unicode.org/versions/Unicode-4.0.0>
- [UCD] Unicode Character Database. <http://www.unicode.org/Public/UNIDATA/UCD.html>
For and overview of the Unicode Character Database and a list of its associated files
- [Unicode] The latest version of the Unicode Standard can be found at <http://www.unicode.org/versions/latest>
- [XML] Unicode Technical Report #20: *Unicode in XML and other Markup Languages*
<http://www.unicode.org/unicode/reports/tr20/>
- [Versions] Versions of the Unicode Standard
<http://www.unicode.org/unicode/standard/versions/>
For details on the precise contents of each version of the Unicode Standard, and how to cite them.
- [XML] Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, Eds., *Extensible Markup Language (XML) 1.0 (Second Edition)*, W3C Recommendation 6–October–2000, <<http://www.w3.org/TR/REC-xml>>

Additional References

The following four books are entirely about the composition of mathematics

- [Chaundy] T.W. Chaundy, P.R. Barrett and Charles Batey, *The Printing of Mathematics*, (London: Oxford University Press 1954, third impression, 1965) [out of print]
- [Wick] Karel Wick, *Rules for Type-setting Mathematics*, (Prague: Publishing House of the Czechoslovak Academy of Sciences 1965) [out of print]
- [Swanson] Ellen Swanson, *Mathematics into Type*, (Providence, RI: American Mathematical Society, 1971, revised 1979, updated 1999 by Arlene O'Sean and Antoinette Schleyer)
The original edition is based on "traditional" composition (Monotype and "cold type", that is Varityper and

Selectric Composer; the 1979 edition adds material for computer composition, and the 1999 edition mostly assumes $T_E X$ or a comparably advanced system.

[Byrd] *Mathematics in Type*, (Richmond, VA: The William Byrd Press 1954) [out of print]

The following books contain material on mathematical composition, but it is not the principal topic covered

[Maple] *The Maple Press Company Style Book*, (York, PA: 1931) (reprinted 1942)
Contains sections on fractions; mathematical signs; simple equations; alignment of equations; braces, brackets and parentheses; integrals, sigmas and infinities; hyphens, dashes and minus signs; superiors and inferiors; ...
[out of print]

[Manual] *A Manual of Style, Twelfth Edition, Revised* (Chicago: The University of Chicago Press 1969)
A chapter "Mathematics in Type" was produced using the Penta (computer) system.

Acknowledgements

Patrick Ion graciously reviewed the text of this report and suggested many improvements. Rick McGowan redrew many of the figures. Magda Danish managed the collection of glyph images for the tables of negated operators..

Modifications

Changes from Tracking Number 5

Rewrote the Overview. Brought table 2.7 into alignment with the standardized variant listing in the Unicode Character Database: 2278 and 2279 have been moved to table 2.5. 2225 was removed from table 2.7 since there is now a new character 2AFD and the variation is no longer needed. Added Table 2.3. Removed section 3.3. Renumbered the appendix to become Section 5. Moved the actual classification of characters into a separate datafile. Updated references to the Unicode Standard to Unicode 4.0 where appropriate. Improved the layout of tables 2.5, 2.6 and 2.7. Many minor spelling, wording and formatting fixes throughout. Updated status and conformance section. Completed the classification in sections 3.1.1 and 3.1.2..

Changes from Tracking Number 4

Added section 2.16. Added section 3.3. Removed section 5. Added Appendix A. Added a few typographical samples. (AF)

Changes from Tracking Number 3

Fixed some CSS issues.

Changes from Tracking Number 2

Changed many special symbols to NCRs. Fixed an HTML glitch affecting table formatting and fixed contents of Table 2.4. A number of additional typographical mistakes and inconsistencies in the original proposed draft have been corrected. Merged duplicated text in section 2.7 and made additional revisions to further align the text with Unicode 3.2. Minor wording changes for clarity or consistency throughout. (bnb/AF).

Changes from Tracking Number 1

A large number of minor, but annoying typographical and HTML mistakes in the original proposed draft have been corrected. This includes the occasional mistaken character name or code point. Additional entries were made to the references section and new bookmarks and internal links have been added to refer to them from the text. Other minor improvements to the text and

formatting have been carried out. Added section 2.10 and revised the first paragraph of section 2 to bring the text inline with Unicode 3.2 (bnb/AF)

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```

# MathClass-6.txt
# Last revised 05/22/03
#
# This is a DRAFT of a classification of
# characters based on their usage in mathematical
# notation and providing a mapping to standard entity sets
# commonly used for SGML and MathML documents.
#
# *ALL* aspects of this file are subject to change
# without notice. This file is *NOT* formally part of the Unicode
# Character data base at this time.
#
# The file consists of 5 fields.
# The character encoding of the file is ISO 8859-1
# [the only non-ASCII character is in the ed. notes, once these are
# removed
# the file will be in the ASCII subset of UTF-8]
#
# 0: code point or range
# The code point field is not unique - where ISO entity sets
# overlap,
# the same code point may be present several times with
# different
# mappings
# 1: class
# 2: entity name
# 3: ISO entity set
# 4: descriptive comments (of various types)
# the descriptive comments provides more information
# about a character,
# or its specific appearance. Some descriptions contain
# common macro
# names (w/ slash)m but in the majority of cases, the
# description
# is simply the description of the entity in the published
# entity set, if
# different from the formal Unicode character name. Minor
# differences in
# word order, punctuation and verb forms have been
# ignored, but not
# systematic differences in terminology, such as filled vs.
# black.
# In principle this allows location of entities by their
# description.
#
# These fields are followed by # and the Unicode name (or name
# range),
# in all caps.
#
#
#
# For more information see TR#25
# -----
# code point;class;entity name;entity set;note;description #
# CHARACTER NAME
0021;P;excl;ISONUM; # EXCLAMATION MARK
0021;N;fact;; # FACTORIAL
0023;N;num;ISONUM; # NUMBER SIGN
0024;N;dollar;ISONUM; # DOLLAR SIGN
0025;N;percnt;ISONUM; # PERCENT SIGN
0026;N;amp;ISONUM; # AMPERSAND
0028;O;lpar;ISONUM; # LEFT PARENTHESIS
0029;C;rpar;ISONUM; # RIGHT PARENTHESIS
002A;N;ast;ISONUM;[high, not /ast] # ASTERISK
002B;B;plus;; # PLUS SIGN
002C;P;comma;ISONUM; # COMMA
002D;R;;(deprecated for math) # HYPHEN-MINUS
002E;P;period;ISONUM;period # FULL STOP
002F;R;sol;ISONUM; # SOLIDUS
0030..0039;N;;; # DIGIT 0..9
003A;P;colon;ISONUM; # COLON
003B;P;semi;; # SEMICOLON
003C;R;lt;; # LESS-THAN SIGN
003D;R;equals;; # EQUALS SIGN
003E;R;gt;; # GREATER-THAN SIGN
003F;P;quest;ISONUM; # QUESTION MARK
0040;N;commat;ISONUM; # COMMERCIAL AT
0041..004B;A;;; # LATIN CAPITAL LETTER A..K

```

```

004C;A;;; # LATIN CAPITAL LETTER L
004D..005A;A;;; # LATIN CAPITAL LETTER M..Z
005B;O;lsqb;ISONUM; # LEFT SQUARE BRACKET
005C;N;bsol;ISONUM; # REVERSE SOLIDUS
005D;C;rsqb;ISONUM; # RIGHT SQUARE BRACKET
0061..007A;A;;; # LATIN SMALL LETTER a..z
007B;O;lcub;ISONUM; # LEFT CURLY BRACKET
007C;F;verbar;ISONUM; # VERTICAL BAR
007D;C;rcub;ISONUM; # RIGHT CURLY BRACKET
00A1;P;iexcl;ISONUM; # INVERTED EXCLAMATION MARK
00A2;N;cent;ISONUM; # CENT SIGN
00A3;N;pound;ISONUM; # POUND SIGN
00A4;N;curren;ISONUM; # CURRENCY SIGN
00A5;N;yen;ISONUM; # YEN SIGN
00A6;N;brvbar;ISONUM;(vertical) # BROKEN BAR
00A7;N;sect;ISONUM; # SECTION SIGN
00AC;N;not;ISONUM;/neg /lnot # NOT SIGN
00B0;N;deg;ISONUM; # DEGREE SIGN
00B1;B;plusmn;ISONUM; # PLUS-OR-MINUS SIGN
00B2;sup2;ISONUM; # SUPERSCRIPT TWO
00B3;sup3;ISONUM; # SUPERSCRIPT THREE
00B5;N;micro;ISONUM; # MICRO SIGN
00B6;N;para;ISONUM;(paragraph sign) # PILCROW SIGN
00B7;B;middot;ISONUM;/centerdot # MIDDLE DOT
00B8;N;sup1;ISONUM; # SUPERSCRIPT ONE
00BC;N;frac14;ISONUM; # VULGAR FRACTION ONE QUARTER
00BD;N;frac12;ISONUM; # VULGAR FRACTION ONE HALF
00BE;N;frac34;ISONUM; # VULGAR FRACTION THREE QUARTERS
00BF;P;quest;ISONUM; # INVERTED QUESTION MARK
00D7;B;times;ISONUM; # MULTIPLICATION SIGN
00F7;B;divide;ISONUM; # DIVISION SIGN
0131;A;imath;ISOAMSO; # LATIN SMALL LETTER DOTLESS I
0300;D;grave;ISODIA; # COMBINING GRAVE ACCENT
0301;D;acute;ISODIA; # COMBINING ACUTE ACCENT
0302;D;circ;ISODIA; # COMBINING CIRCUMFLEX ACCENT
0303;D;tilde;ISODIA; # COMBINING TILDE
0304;D;macr;ISODIA; # COMBINING MACRON
0305;D;;; # COMBINING OVERLINE
0306;D;breve;ISODIA; # COMBINING BREVE
0307;D;dot;ISODIA; # COMBINING DOT ABOVE
0308;D;die;ISODIA; # COMBINING DIAERESIS
0308;D;Dot;ISOTECH; # COMBINING DIAERESIS
030A;D;ring;ISODIA; # COMBINING RING ABOVE
030C;D;caron;ISODIA; # COMBINING CARON
0311;D;;; # COMBINING INVERTED BREVE
0323;D;udot;; # COMBINING DOT BELOW
032C;D;ucaron;; # COMBINING CARON BELOW
032D;D;ucirc;; # COMBINING CIRCUMFLEX ACCENT BELOW
032E;D;ubreve;; # COMBINING BREVE BELOW
032F;D;;; # COMBINING INVERTED BREVE BELOW
0330;D;utilde;; # COMBINING TILDE BELOW
0331;D;;; # COMBINING MACRON BELOW
0332;D;;; # COMBINING LOW LINE
0333;D;2lowbar;; # COMBINING DOUBLE LOW LINE
0338;D;;;negation slash # COMBINING LONG SOLIDUS OVERLAY
033A;D;;; # COMBINING INVERTED BRIDGE BELOW
033F;D;;; # COMBINING DOUBLE OVERLINE
0346;D;;; # COMBINING BRIDGE ABOVE
0391;A;Agr;ISOGRK1; # GREEK CAPITAL LETTER ALPHA
0392;A;Bgr;ISOGRK1; # GREEK CAPITAL LETTER BETA
0393;A;Gamma;ISOGRK3; # GREEK CAPITAL LETTER GAMMA
0394;A;Delta;ISOGRK3; # GREEK CAPITAL LETTER DELTA
0395;A;Egr;ISOGRK1; # GREEK CAPITAL LETTER EPSILON
0396;A;Zgr;ISOGRK1; # GREEK CAPITAL LETTER ZETA
0397;A;EEgr;ISOGRK1; # GREEK CAPITAL LETTER ETA
0398;A;Theta;ISOGRK3; # GREEK CAPITAL LETTER THETA
0399;A;Igr;ISOGRK1; # GREEK CAPITAL LETTER IOTA
039A;A;Kgr;ISOGRK1; # GREEK CAPITAL LETTER KAPPA
039B;A;Lambda;ISOGRK3; # GREEK CAPITAL LETTER LAMDA
039C;A;Mgr;ISOGRK1; # GREEK CAPITAL LETTER MU
039D;A;Ngr;ISOGRK1; # GREEK CAPITAL LETTER NU
039E;A;Xi;ISOGRK3; # GREEK CAPITAL LETTER XI
039F;A;Ogr;ISOGRK1; # GREEK CAPITAL LETTER OMICRON
03A0;A;Pi;ISOGRK3; # GREEK CAPITAL LETTER PI
03A1;A;Rgr;ISOGRK1; # GREEK CAPITAL LETTER RHO
03A3;A;Sigma;ISOGRK3; # GREEK CAPITAL LETTER SIGMA
03A4;A;Tgr;ISOGRK1; # GREEK CAPITAL LETTER TAU
03A6;A;Phi;ISOGRK3; # GREEK CAPITAL LETTER PHI

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03A7;A;KHgr;ISOGRK1; # GREEK CAPITAL LETTER CHI
 03A8;A;Psi;ISOGRK3; # GREEK CAPITAL LETTER PSI
 03A9;A;Omega;ISOGRK3; # GREEK CAPITAL LETTER OMEGA
 03B1;A;alpha;ISOGRK3; # GREEK SMALL LETTER ALPHA
 03B2;A;beta;ISOGRK3; # GREEK SMALL LETTER BETA
 03B3;A;gamma;ISOGRK3; # GREEK SMALL LETTER GAMMA
 03B4;A;delta;ISOGRK3; # GREEK SMALL LETTER DELTA
 03B5;A;epsiv;ISOGRK3;rounded # GREEK SMALL LETTER EPSILON
 03B6;A;zeta;ISOGRK3; # GREEK SMALL LETTER ZETA
 03B7;A;eta;ISOGRK3; # GREEK SMALL LETTER ETA
 03B8;A;theta;ISOGRK3;straight theta # GREEK SMALL LETTER THETA
 03B9;A;iota;ISOGRK3; # GREEK SMALL LETTER IOTA
 03BA;A;kappa;ISOGRK3; # GREEK SMALL LETTER KAPPA
 03BB;A;lambd;ISOGRK3; # GREEK SMALL LETTER LAMBDA
 03BC;A;mu;ISOGRK3; # GREEK SMALL LETTER MU
 03BD;A;nu;ISOGRK3; # GREEK SMALL LETTER NU
 03BE;A;xi;ISOGRK3; # GREEK SMALL LETTER XI
 03BF;A;ogr;ISOGRK1; # GREEK SMALL LETTER OMICRON
 03C0;A;pi;ISOGRK3; # GREEK SMALL LETTER PI
 03C1;A;rho;ISOGRK3; # GREEK SMALL LETTER RHO
 03C3;A;sigma;ISOGRK3; # GREEK SMALL LETTER SIGMA
 03C4;A;tau;ISOGRK3; # GREEK SMALL LETTER TAU
 03C5;A;upsi;ISOGRK3; # GREEK SMALL LETTER UPSILON
 03C6;A;phi;ISOGRK3;/straightphi # GREEK SMALL LETTER PHI
 03C7;A;chi;ISOGRK3; # GREEK SMALL LETTER CHI
 03C8;A;psi;ISOGRK3; # GREEK SMALL LETTER PSI
 03C9;A;omega;ISOGRK3; # GREEK SMALL LETTER OMEGA
 03D1;A;thetav;ISOGRK3;/vartheta - curly or open small theta # GREEK THETA SYMBOL
 03D2;A;Upsi;ISOGRK3; # GREEK UPSILON WITH HOOK SYMBOL
 03D5;A;phiv;ISOGRK3;curly or open, small letter # GREEK PHI SYMBOL
 03D6;A;piv;ISOGRK3;rounded (pomega) # GREEK PI SYMBOL
 03D8;N;;; # GREEK LETTER ARCHAIC KOPPA
 03D9;N;;; # GREEK SMALL LETTER ARCHAIC KOPPA
 03DA;A;;;capital # GREEK LETTER STIGMA
 03DB;A;stigma;; # GREEK SMALL LETTER STIGMA
 03DC;A;Gammad;ISOGRK3;capital # GREEK LETTER DIGAMMA
 03DD;A;gammad;ISOGRK3;old # GREEK SMALL LETTER DIGAMMA
 03E0;A;;;capital # GREEK LETTER SAMPI
 03E1;A;sampi;; # GREEK SMALL LETTER SAMPI
 03F0;A;kappav;ISOGRK3;rounded # GREEK SMALL LETTER KAPPA
 03F1;A;rhov;ISOGRK3;rounded # GREEK SMALL LETTER RHO
 03F4;A;Thetav;; # GREEK CAPITAL THETA SYMBOL
 03F5;A;epsi;ISOGRK3; # GREEK LUNATE EPSILON SYMBOL
 03F6;N;bepsi;ISOAMSR; # GREEK REVERSED LUNATE EPSILON SYMBOL
 0429;A;SHCHcy;ISOCYR1; # CYRILLIC CAPITAL LETTER SHCHA
 2002;;ensp;ISOPUB;(half an em) # EN SPACE
 2003;;emsp;ISOPUB; # EM SPACE
 2010;P;hyphen;ISONUM;(true graphic) # HYPHEN
 2012;P;dash;ISOPUB; # FIGURE DASH
 2013;P;ndash;ISOPUB; # EN DASH
 2014;P;mdash;ISOPUB; # EM DASH
 2016;F;Verbar;ISOTECH; # DOUBLE VERTICAL BAR
 2020;R;dagger;ISOAMSB; # DAGGER RELATION
 2020;N;dagger;ISOPUB; # DAGGER
 2021;R;Dagger;ISOAMSB; # DOUBLE DAGGER RELATION
 2021;N;Dagger;ISOPUB; # DOUBLE DAGGER
 2022;B;bull;ISOPUB;/bullet round bullet, filled # BULLET
 2026;N;hellip;ISOPUB; # HORIZONTAL ELLIPSIS
 2032;N;prime;ISOTECH;minute # PRIME
 2033;N;Prime;ISOTECH;second # DOUBLE PRIME
 2034;N;tprime;ISOTECH; # TRIPLE PRIME
 2035;N;bprime;ISOAMSO; # REVERSE PRIME
 2036;N;bPrime;; # DOUBLE REVERSE PRIME
 2037;N;btprime;; # TRIPLE REVERSE PRIME
 203B;N;;;japanese kome # REFERENCE MARK
 2040;B;;;z notation sequence concatenation # CHARACTER TIE
 204E;N;lowast;ISOTECH; # LOW ASTERISK
 204F;R;bsemi;ISOAMSO; # REVERSED SEMICOLON
 2050;R;closur;; # CLOSE UP
 2051;N;Ast;; # TWO ASTERISKS ALIGNED VERTICALLY
 2057;N;qprime;ISOTECH; # QUADRUPLE PRIME
 205F;N;;; # MEDIUM MATHEMATICAL SPACE
 2061;;; # FUNCTION APPLICATION
 2062;;; # INVISIBLE TIMES

2063;;; # INVISIBLE SEPARATOR
 20D0;D;;; # COMBINING LEFT HARPOON ABOVE
 20D1;D;;; # COMBINING RIGHT HARPOON ABOVE
 20D2;D;;; # COMBINING LONG VERTICAL LINE OVERLAY
 20D6;D;;; # COMBINING LEFT ARROW ABOVE
 20D7;D;;; # COMBINING RIGHT ARROW ABOVE
 20DB;D;tdot;ISOTECH; # COMBINING THREE DOTS ABOVE
 20DC;D;DotDot;ISOTECH; # COMBINING FOUR DOTS ABOVE
 20E1;D;;; # COMBINING LEFT RIGHT ARROW ABOVE
 20E4;D;;; # COMBINING ENCLOSING UPWARD POINTING TRIANGLE
 20E5;D;;; # COMBINING REVERSE SOLIDUS OVERLAY
 20E6;D;;; # COMBINING DOUBLE VERTICAL STROKE OVERLAY
 20E7;D;;;actuary # COMBINING ANNUITY SYMBOL
 20E8;D;;; # COMBINING TRIPLE UNDERDOT
 20E9;D;;; # COMBINING WIDE BRIDGE ABOVE
 20EA;D;;; # COMBINING LEFTWARDS OVERLAY
 2102;A;Copf;ISOMOPF;/Bbb C, open face C # DOUBLE-STRUCK CAPITAL C
 2107;N;;; # EULER CONSTANT
 210A;A;gscr;ISOMSCR;/scr g # SCRIPT SMALL G
 210B;A;Hscr;ISOMSCR;/scr H # SCRIPT CAPITAL H
 210C;A;Hfr;ISOMFRK;/frak H # BLACK-LETTER CAPTITAL H
 210D;A;Hopf;ISOMOPF;/Bbb H # DOUBLE-STRUCK CAPITAL H
 210E;N;;; # PLANCK CONSTANT
 210F;N;plankv;ISOAMSO;/hslash - variant # PLANCK CONSTANT OVER TWO PI
 2110;A;Iscr;ISOMSCR;/scr I # SCRIPT CAPITAL I
 2111;A;image;ISOAMSO;imaginary part # BLACK-LETTER CAPITAL I
 2112;A;lagran;ISOTECH;Lagrangian # SCRIPT CAPITAL L
 2113;A;ell;ISOAMSO;cursive small l # SCRIPT SMALL L
 2115;A;Nopf;ISOMOPF;/Bbb N, open face N # DOUBLE-STRUCK N
 2118;A;weierp;ISOAMSO;Weierstrass p (Unicode name is a misnomer) # SCRIPT CAPITAL P
 2119;A;Popf;ISOMOPF;/Bbb P, open face P # DOUBLE-STRUCK CAPITAL P
 211A;A;Qopf;ISOMOPF;/Bbb Q, open face Q # DOUBLE-STRUCK CAPTIAL Q
 211B;A;Rscr;ISOMSCR;/scr R # SCRIPT CAPITAL R
 211C;A;real;ISOAMSO; # BLACK-LETTER CAPITAL R
 211D;A;Ropf;ISOMOPF;/Bbb R, open face R # DOUBLE-STRUCK CAPITAL R
 2124;A;Zopf;ISOMOPF;/Bbb Z, open face Z # DOUBLE-STRUCK CAPITAL Z
 2126;N;ohm;ISONUM;(deprecated in math, use greek letter) # OHM SIGN
 2127;N;mho;ISOAMSO;conductance # INVERTED OHM
 2128;A;Zfr;ISOMFRK;/frak Z # BLACK LETTER CAPITAL Z
 2129;N;iota;ISOAMSO;inverted iota # TURNED GREEK SMALL LETTER IOTA
 212B;A;angst;ISOTECH;Angstrom capital A, ring(deprecated in math) # ANGSTROM SIGN
 212C;A;bernou;ISOTECH;Bernoulli function # SCRIPT CAPITAL B
 212D;A;Cfr;ISOMFRK; # BLACK-LETTER CAPITAL C
 212F;A;escri;ISOMSCR;/scr e # SCRIPT SMALL E
 2130;A;Escri;ISOMSCR;/scr E # SCRIPT CAPITAL E
 2131;A;Fscri;ISOMSCR;/scr F # SCRIPT CAPITAL F
 2132;N;;; # TURNED CAPITAL F
 2133;A;phmmat;ISOTECH;physics M-matrix # SCRIPT CAPITAL M
 2134;A;order;ISOTECH;order of # SCRIPT SMALL O
 2135;A;aleph;ISOTECH;aleph, Hebrew # ALEPH SIGN
 2136;A;beth;ISOAMSO;beth, Hebrew # BETH SIGN
 2137;A;gimel;ISOAMSO;gimel, Hebrew # GIMEL SIGN
 2138;A;daleth;ISOAMSO;daleth, Hebrew # DALETH SIGN
 213D;A;opfgamma;; # DOUBLE-STRUCK SMALL GAMMA
 213E;N;opfGam;; # DOUBLE-STRUCK CAPITAL GAMMA
 213F;A;opfPi;; # DOUBLE-STRUCK CAPITAL PI
 2140;L;opfsum;; # DOUBLE-STRUCK N-ARY SUMMATION
 2141;N;Game;; # TURNED SANS-SERIF CAPITAL G
 2142;N;;; # TURNED SANS-SERIF CAPITAL L
 2143;N;;; # REVERSED SANS-SERIF CAPITAL L
 2144;N;;; # TURNED SANS-SERIF CAPITAL Y
 2145;N;;; # DOUBLE-STRUCK ITALIC CAPITAL D
 2146;N;;; # DOUBLE-STRUCK ITALIC SMALL D
 2147;N;;; # DOUBLE-STRUCK ITALIC SMALL E
 2148;N;;; # DOUBLE-STRUCK ITALIC SMALL I
 2149;N;;; # DOUBLE-STRUCK ITALIC SMALL J

214B;N;turnamp;; # TURNED AMPERSAND
 2190;R;larr;ISONUM;/leftarrow /gets # LEFTWARD ARROW
 2191;R;uarr;ISONUM # UPWARD ARROW
 2192;R;rarr;ISONUM;/rightarrow /to # RIGHTWARD ARROW
 2193;R;darr;ISONUM # DOWNWARD ARROW
 2194;R;harr;ISOAMSA;left and right arrow # LEFT RIGHT ARROW
 2195;R;varr;ISOAMSA;up and down arrow # UP DOWN ARROW
 2196;R;nwarr;ISOAMSA;NW pointing arrow # NORTH WEST ARROW
 2197;R;nearr;ISOAMSA;NE pointing arrow # NOTRH EAST ARROW
 2198;R;searr;ISOAMSA;SE pointing arrow # SOUTH EAST ARROW
 2199;R;swarr;ISOAMSA;SW pointing arrow # SOUTH WEST ARROW
 219A;R;nlarr;ISOAMSA;not left arrow # LEFTWARDS ARROW WITH STROKE
 219B;R;nrarr;ISOAMSA;not right arrow # RIGHTWARDS ARROW WITH STROKE
 219C;R;larrrw;left arrow-wavy # LEFTWARDS WAVE ARROW
 219D;R;rarrw;ISOAMSA;right arrow-wavy # RIGHTWARDS WAVE ARROW
 219E;R;Larr;ISOAMSA; # LEFTWARDS TWO HEADED ARROW
 219F;R;Uarr;ISOAMSA; # UPWARDS TWO HEADED ARROW
 21A0;R;Rarr;ISOAMSA; # RIGHTWARDS TWO HEADED ARROW
 21A1;R;Darr;ISOAMSA; # DOWNWARDS TWO HEADED ARROW
 21A2;R;larrtl;ISOAMSA;left arrow-tailed # LEFTWARDS ARROW WITH TAIL
 21A3;R;rarrtl;ISOAMSA;right arrow-tailed # RIGHTWARDS ARROW WITH TAIL
 21A4;R;mapstoleft;;maps to, leftward # LEFTWARDS ARROW FROM BAR
 21A5;R;mapstoup;;maps to, upward # UPWARDS ARROW FROM BAR
 21A6;R;map;ISOAMSA;maps to, rightward # RIGHTWARDS ARROW FROM BAR
 21A7;R;mapstodown;;maps to, downward # DOWNWARDS ARROW FROM BAR
 21A8;R;varrb;up and down arrow, bar under # UP DOWN ARROW WITH BASE
 21A9;R;larrrhk;ISOAMSA; # LEFT ARROW WITH HOOK
 21AA;R;rarrhk;ISOAMSA; # RIGHT ARROW WITH HOOK
 21AB;R;larrrlp;ISOAMSA; # LEFT ARROW WITH LOOP
 21AC;R;rarrlpISOAMSA;; # RIGHT ARROW WITH LOOP
 21AD;R;harrw;ISOAMSA;left and right arr-wavy # LEFT RIGHT WAVE ARROW
 21AE;R;nharr;ISOAMSA;not left and right arrow # LEFT RIGHT ARROW WITH STROKE
 21AF;R;zigdarr;; # DOWNWARDS ZIGZAG ARROW
 21B0;R;lsh;ISOAMSA;/Lsh # UPWARDS ARROW WITH TIP LEFTWARDS
 21B1;R;rsh;ISOAMSA;/Rsh # UPWARDS ARROW WITH TIP RIGHTWARDS
 21B2;R;ldsh;ISOAMSA;left down angled arrow # DOWNWARDS ARROW WITH TIP LEFTWARDS
 21B3;R;rdsh;ISOAMSA;right down angled arrow # DOWNWARDS ARROW WITH TIP RIGHTWARDS
 21B6;R;cularr;ISOAMSA;left curved arrow # ANTICLOCKWISE TOP SEMICIRCLE ARROW
 21B7;R;curarr;ISOAMSA;right curved arrow # CLOCKWISE TOP SEMICIRCLE ARROW
 21BA;R;;; # ANTICLOCKWISE OPEN CIRCLE ARROW
 21BB;R;;; # CLOCKWISE OPEN CIRCLE ARROW
 21BC;R;lharu;ISOAMSA;left harpoon-up # LEFTWARDS HARPOON WITH BARB UPWARDS
 21BD;R;lhard;ISOAMSA;left harpoon-down # LEFTWARDS HARPOON WITH BARB DOWNWARDS
 21BE;R;uharr;ISOAMSA;/upharpoonright /restriction up harpoon-right # UPWARDS HARPOON WITH BARB RIGHTWARDS
 21BF;R;uharl;ISOAMSA;up harpoon-left # UPWARDS HARPOON WITH BARB LEFTAWRDS
 21C0;R;rharu;ISOAMSA;right harpoon-up # RIGHTWARDS HARPOON WITH BARB UPWARDS
 21C1;R;rharr;ISOAMSA;right harpoon-down # RIGHTWARDS HARPOON WITH BARB DOWNWARDS
 21C2;R;dharr;ISOAMSA;down harpoon-right # DOWNWARDS HARPOON WITH BARB RIGHTAWRDS
 21C3;R;dharl;ISOAMSA;down harpoon-left # DOWNWARDS HARPOON WITH BARB LEFTAWRDS
 21C4;R;rlarr;ISOAMSA;right arrow over left arrow # RIGHTWARDS ARROW OVER LEFTWARDS ARROW

ARROW LEFTWARDS OF DOWNWARDS ARROW
 21C6;R;lrarr;ISOAMSA;left arrow over right arrow # LEFTWARDS ARROW OVER RIGHTWARDS ARROW
 21C7;R;llarr;ISOAMSA;two left arrows # LEFTWARDS PAIRED ARROWS
 21C8;R;uarr;ISOAMSA;two up arrows # UPWARDS PAIRED ARROWS
 21C9;R;rrarr;ISOAMSA;two right arrows # RIGHTWARDS PAIRED ARROWS
 21CA;R;ddarr;ISOAMSA;two down arrows # DOWNWARDS PAIRED ARROWS
 21CB;R;lrhar;ISOAMSA;left harpoon over right # LEFTWARDS HARPOON OVER RIGHTWARDS HARPOON
 21CC;R;rlhar;ISOAMSA;right harpoon over left # RIGHTWARDS HARPOON OVER LEFTWARDS HARPOON
 21CD;R;nlArr;;not implied by # LEFTWARD DOUBLE ARROW WITH STROKE
 21CE;R;nhArr;;not left and right double arrows # LEFT RIGHT DOUBLE ARROW WITH STROKE
 21CF;R;nrArr;;not implies # RIGHTWARDS DOUBLE ARROW WITH STROKE
 21D0;R;IArr;ISOTECH;is implied by # LEFTWARDS DOUBLE ARROW
 21D1;R;uArr;ISOAMSA;up double arrow # UPWARDS DOUBLE ARROW
 21D2;R;rArr;ISOTECH;implies # RIGHTWARDS DOUBLE ARROW
 21D3;R;dArr;ISOAMSA;down double arrow # DOWNWARDS DOUBLE ARROW
 21D4;R;hArr;ISOAMSA;left and right double arrow # LEFT RIGHT DOUBLE ARROW
 21D5;R;vArr;ISOAMSA;up and down double arrow # UP DOWN DOUBLE ARROW
 21D6;R;nwArr;ISOAMSA;NW pointing double arrow # NORTH WEST DOUBLE ARROW
 21D7;R;neArr;ISOAMSA;NE pointing double arrow # NORTH EAST DOUBLE ARROW
 21D8;R;seArr;ISOAMSA;SE pointing double arrow # SOUTH EAST DOUBLE ARROW
 21D9;R;swArr;ISOAMSA;SW pointing double arrow # SOUTH WEST DOUBLE ARROW
 21DA;R;lAarr;ISOAMSA;left triple arrow # LEFTWARDS TRIPLE ARROW
 21DB;R;rAarr;ISOAMSA;right triple arrow # RIGHTWARDS TRIPLE ARROW
 21DC;R;ziglarr;;left zig-zag arrow # LEFTWARDS SQUIGGLE ARROW
 21DD;R;zigrarr;ISOAMSA;right zig-zag arrow # RIGHTWARDS SQUIGGLE ARROW
 21DE;R;;; # UPWARDS ARROW WITH DOUBLE STROKE
 21DF;R;;; # DOWNWARDS ARROW WITH DOUBLE STROKE
 21E0;R;;; # LEFTWARDS DASHED ARROW
 21E1;R;;; # UPWARDS DASHED ARROW
 21E2;R;;; # RIGHTWARDS DASHED ARROW
 21E3;R;;; # DOWNWARDS DASHED ARROW
 21E4;R;larrrb;; # LEFTWARDS ARROW TO BAR
 21E5;R;rarrb;; # RIGHTWARDS ARROW TO BAR
 21E6;R;;; # LEFTWARDS WHITE ARROW
 21E7;R;;; # UPWARDS WHITE ARROW
 21E8;R;;; # RIGHTWARDS WHITE ARROW
 21E9;R;;; # DOWNWARDS WHITE ARROW
 21F4;R;;; # RIGHT ARROW WITH SMALL CIRCLE
 21F5;R;duarr;ISOAMSA; # DOWNWARDS ARROW LEFTWARDS OF UPWARDS ARROW
 21F6;R;rarr3;; # THREE RIGHTWARDS ARROWS
 21F7;R;nvlarr;; # LEFTWARDS ARROW WITH VERTICAL STROKE
 21F8;R;nvrarr;; # RIGHTWARDS ARROW WITH VERTICAL STROKE
 21F9;R;nvharr;; # LEFT RIGHT ARROW WITH VERTICAL STROKE
 21FA;R;;; # LEFTWARDS ARROW WITH DOUBLE VERTICAL STROKE
 21FB;R;;; # RIGHTWARDS ARROW WITH DOUBLE VERTICAL STROKE
 21FC;R;;; # LEFT RIGHT ARROW WITH DOUBLE VERTICAL STROKE
 21FD;R;loarr;ISOAMSA; # LEFTWARDS OPEN-HEADED ARROW
 21FE;R;roarr;ISOAMSA; # RIGHTWARDS OPEN-HEADED ARROW
 21FF;R;hoarr;ISOAMSA; # LEFT RIGHT OPEN-HEADED ARROW
 2200;N;forall;ISOTECH; # FOR ALL
 2201;N;comp;ISOAMSO; # COMPLEMENT
 2202;N;part;ISOTECH; # PARTIAL DIFFERENTIAL
 2203;N;exist;ISOTECH;at least one exists # THERE EXISTS
 2204;N;nexist;ISOAMSO;negated exists # THERE DOES NOT EXIST

2205;N;emptyv;ISOAMSO;circle, slash # EMPTY SET
 2206;N;;;Laplacian (Delta, nabla²) # INCREMENT
 2207;N;nabla;ISOTECH;nabla, del, Hamilton operator # NABLA
 2208;R;isinv;ISOTECH;set membership, variant # ELEMENT OF
 2209;R;notin;ISOTECH;negated set membership # NOT AN ELEMENT OF
 220A;R;isin;ISOTECH;set membership # SMALL ELEMENT OF
 220B;R;niv;ISOTECH;contains, variant # CONTAINS AS MEMBER
 220C;R;notni;ISOTECH;negated contains, variant # DOES NOT CONTAIN AS MEMBER
 220D;R;ni;ISOTECH;/ni /owns contains # SMALL DOES NOT CONTAIN AS MEMBER
 220E;N;qed;; # END OF PROOF
 220F;L;prod;ISOAMSO;product operator # N-ARY PRODUCT
 2210;L;coprod;ISOAMSB;coproduct operator # N-ARY CODPRODUCT
 2211;L;sum;ISOAMSB;summation operator # N-ARY SUMATION
 2212;B;minus;ISOTECH; # MINUS SIGN
 2213;B;mnplus;; # MINUS-OR-PLUS SIGN
 2214;B;plusdo;ISOAMSB;plus sign, dot above # DOT PLUS
 2215;B;;; # DIVISION SLASH
 2216;B;ssetmn;ISOAMSB;small set minus (cf. reverse solidus) # SET MINUS
 2217;B;midast;ISOAMSB;centered asterisk # ASTERISK OPERATOR
 2218;B;compfn;ISOTECH;composite function (small circle) # RING OPERATOR
 2219;B;;; # BULLET OPERATOR
 221A;O;radic;ISOTECH;radical # SQUARE ROOT
 221B;O;;; # CUBE ROOT
 221C;O;;; # FOURTH ROOT
 221D;R;prop;ISOTECH; # PROPORTIONAL TO
 221E;N;infin;ISOTECH; # INFINITY
 221F;N;angrt;ISOTECH;(90 degree) # RIGHT ANGLE
 2220;N;ang;ISOAMSO; # ANGLE
 2221;N;angmsd;ISOAMSO; # MEASURED ANGLE
 2222;N;angsph;ISOTECH; # SPHERICAL ANGLE
 2223;R;mid;ISOAMSR;/mid # DIVIDES
 2224;R;nmid;ISOAMSN;negated mid # DOES NOT DIVIDE
 2225;R;par;ISOTECH; # PARALLEL TO
 2226;R;npar;ISOAMSN; # NOT PARALLEL TO
 2227;B;and;ISOTECH;/wedge /land # LOGICAL AND
 2228;B;or;ISOTECH;/vee /lor # LOGICAL OR
 2229;B;cap;ISOTECH; # INTERSECTION
 222A;B;cup;ISOTECH;logical sum # UNION
 222B;L;int;ISOTECH; # INTEGRAL
 222C;L;Int;ISOTECH; # DOUBLE INTEGRAL
 222D;L;tint;ISOTECH; # TRIPLE INTEGRAL
 222E;L;conint;ISOTECH; # CONTOUR INTEGRAL
 222F;L;Conint;ISOTECH;double contour integral operator # SURFACE INTEGRAL
 2230;L;Cconint;ISOTECH;triple contour integral operator # VOLUME INTEGRAL
 2231;L;cwint;ISOTECH; # CLOCKWISE INTEGRAL
 2232;L;cwconint;ISOTECH; # CONTOUR INTEGRAL, CLOCKWISE
 2233;L;awconint;ISOTECH; # CONTOUR INTEGRAL, ANTICLOCKWISE
 2234;N;there4;ISOTECH; # THEREFORE
 2235;N;becaus;ISOTECH; # BECAUSE
 2236;R;ratio;ISOAMSR; # RATIO
 2237;R;Colon;ISOAMSR;two colons # PROPORTION
 2238;B;minusd;ISOAMSB;minus sign, dot above # DOT MINUS
 2239;R;excess;;excess (-:) # EXCESS
 223A;B;mDDot;ISOAMSR;minus with four dots, geometric properties # GEOMETRIC PROPORTION
 223B;R;homtht;ISOAMSR; # HOMOTHETIC
 223C;R;sim;ISOTECH;similar # TILDE OPERATOR
 223D;R;bsim;ISOAMSR;reverse similar # REVERSE TILDE OPERATOR
 223E;R;ac;ISOAMSB;most positive # INVERTED LAZY S
 223F;;; # SINE WAVE
 2240;B;wreath;ISOAMSB; # WREATH PRODUCT
 2241;R;nsim;ISOAMSO;not similar # NOT TILDE
 2242;R;esim;ISOAMSR;equals, similar # MINUS TILDE
 2243;R;sime;ISOTECH;similar, equals # ASYMPTOTICALLY EQUAL TO
 2244;R;nsime;ISOAMSN;not similar, equals # NOT ASYMPTOTICALLY EQUAL TO
 2245;R;cong;ISOTECH;congruent with # APPROXIMATELY EQUAL

2245;R;cong;ISOTECH;congruent with # APPROXIMATELY EQUAL TO
 2246;R;simne;ISOAMSN;similar, not equals [vert only for 9573 entity] # APPROXIMATELY BUT NOT ACTUALLY EQUAL TO
 2247;R;ncong;ISOAMSN;not congruent with # NEITHER APPROXIMATELY NOR ACTUALLY EQUAL TO
 2248;R;ap;ISOTECH;approximate # ALMOST EQUAL TO
 2249;R;nap;ISOAMSN;not approximate # NOT ALMOST EQUAL TO
 224A;R;ape;ISOAMSR;approximate, equals # ALMOST EQUAL OR EQUAL TO
 224B;R;apid;ISOAMSR;approximately identical to # TRIPLE TILDE
 224C;R;bcong;ISOAMSR; # ALL EQUAL TO
 224D;R;asymp;ISOAMSR;asymptotically equal to # EQUIVALENT TO
 224E;R;bump;ISOAMSR;bumpy equals # GEOMETRICALLY EQUIVALENT TO
 224F;R;bumpe;ISOAMSR;bumpy equals, equals # DIFFERENCE BETWEEN
 2250;R;esdot;ISOAMSR;equals, single dot above # APPROACHES THE LIMIT
 2251;R;eDot;ISOAMSR;/doteqdot /Doteq equals, even dots # GEOMETRICALLY EQUAL TO
 2252;R;efDot;ISOAMSR;equals, falling dots # APPROXIMATELY EQUAL TO OR THE IMAGE OF
 2253;R;erDot;ISOAMSR;equals, rising dots # IMAGE OF OR APPROXIMATELY EQUAL TO
 2254;R;colone;ISOAMSR; # COLON EQUALS
 2255;R;ecolon;ISOAMSR; # EQUALS COLON
 2256;R;ecir;ISOAMSR;circle on equals sign # RING IN EQUAL TO
 2257;R;cire;ISOAMSR;circle, equals # RING EQUAL TO
 2258;R;arceq;;arc, equals # CORRESPONDS TO
 2259;R;wedgedq;ISOTECH;corresponds to (wedge, equals) # ESTIMATES
 225A;R;veeeq;ISOTECH;logical or, equals # EQUIANGULAR TO
 225B;R;;; # STAR EQUALS
 225C;R;trie;ISOAMSR;triangle, equals # DELTA EQUAL TO
 225D;R;eqdef;; # EQUAL TO BY DEFINITION
 225E;R;measeq;;(m over equals) # MEASURED BY
 225F;R;equest;ISOAMSR;equal with questionmark # QUESTIONED EQUAL TO
 2260;R;ne;ISOTECH;/ne /neq # NOT EQUAL TO
 2261;R;equiv;ISOTECH; # IDENTICAL TO
 2262;R;nequiv;ISOAMSN; # NOT IDENTICAL TO
 2263;R;Equiv;;(4 lines) # STRICTLY EQUIVALENT TO
 2264;R;le;ISOTECH;/leq /le # LESS-THAN OR EQUAL TO
 2265;R;ge;ISOTECH;/geq /ge # GREATER-THAN OR EQUAL TO
 2266;R;IE;ISOAMSR;less, double equals # LESS-THAN OVER EQUAL TO
 2267;R;gE;ISOAMSR;greater, double equals # GREATER-THAN OVER EQUAL TO
 2268;R;lnE;ISOAMSN;less, not double equals # LESS-THAN BUT NOT EQUAL TO
 2269;R;gnE;ISOAMSN;greater, not double equals # GREATER-THAN BUT NOT EQUAL TO
 226A;R;;;much less than, type 2 # MUCH LESS THAN
 226B;R;;;much greater than, type 2 # MUCH GREATER THAN
 226C;R;twixt;ISOAMSR; # BETWEEN
 226D;R;nasyp;;not asymptotically equal to # NOT EQUIVALENT TO
 226E;R;nlt;ISOAMSN; # NOT LESS-THAN
 226F;R;ngt;ISOAMSN; # NOT GREATER-THAN
 2270;R;nle;ISOAMSN; # NOT LESS-THAN OR EQUAL
 2271;R;nge;ISOAMSN; # NOT GREATER-THAN OR EQUAL
 2272;R;lsim;ISOAMSR;less, similar # LESS-THAN OR EQUIVALENT TO
 2273;R;gsim;ISOAMSR;greater, similar # GREATER-THAN OR EQUIVALENT TO
 2274;R;nlsim;ISOAMSN;not less, similar # NEITHER LESS-THAN NOR EQUIVALENT TO
 2275;R;ngsim;ISOAMSN;not greater, similar # NEITHER GREATER-THAN NOR EQUIVALENT TO
 2276;R;lg;ISOAMSR;less, greater # LESS-THAN OR GREATER-THAN
 2277;R;gl;ISOAMSR;greater, less # GREATER-THAN OR LESS-THAN
 2278;R;ntlg;ISOAMSN; # NEITHER LESS-THAN NOR GREATER-THAN
 2279;R;ntgl;ISOAMSN; # NEITHER GREATER-THAN NOR LESS-THAN
 227A;R;pr;ISOAMSR; # PRECEDES

227B;R;sc;ISOAMSR; # SUCCEEDS
 227C;R;prcue;ISOAMSR;precedes, curly equals # PRECEDES OR EQUAL TO
 227D;R;scue;ISOAMSR;succeeds, curly equals # SUCCEEDS OR EQUAL TO
 227E;R;prsim;ISOAMSR;precedes, similar # PRECEDES OR EQUIVALENT TO
 227F;R;scsim;ISOAMSR;succeeds, similar # SUCCEEDS OR EQUIVALENT TO
 2280;R;npr;ISOAMSN;not precedes # DOES NOT PRECEDE
 2281;R;nsc;ISOAMSN;not succeeds # DOES NOT SUCCEED
 2282;R;sub;ISOTECH;subset or is implied by # SUBSET OF
 2283;R;sup;ISOTECH;superset or implies # SUPERSET OF
 2284;R;nsb;ISOAMSN; # NOT A SUBSET OF
 2285;R;nsup;ISOAMSN; # NOT A SUPERSET OF
 2286;R;sube;ISOTECH;subset, equals # SUBSET OR EQUAL TO
 2287;R;supe;ISOTECH;superset, equals # SUPERSET OR EQUAL TO
 2288;R;nsbe;ISOAMSN;not subset, equals # NEITHER A SUPERSET NOR EQUAL TO
 2289;R;nsupe;ISOAMSN;not superset, equals # NEITHER A SUBSET NOR EQUAL TO
 228A;R;sbne;ISOAMSN;subset, not equals # SUBSET OF WITH NOT EQUAL TO
 228B;R;supne;ISOAMSN;superset, not equals # SUPERSET OF WITH NOT EQUAL TO
 228C;B;;; # MULTISSET
 228D;B;cupdot;ISOAMSB;union, with dot # MULTISSET MULTIPLICATION
 228E;B;uplus;ISOAMSB;plus sign in union # MULTISSET UNION
 228F;R;sqsub;ISOAMSR;square subset # SQUARE IMAGE OF
 2290;R;sqsup;ISOAMSR;square superset # SQUARE ORIGINAL OF
 2291;R;sqsube;ISOAMSR; square subset, equals; # SQUARE IMAGE OF OR EQUAL TO
 2292;R;sqsupe;ISOAMSR; square superset, equals; # SQUARE ORIGINAL OF OR EQUAL TO
 2293;B;sqcap;ISOAMSB;square intersection # SQUARE CAP
 2294;B;sqcup;ISOAMSB;square union # SQUARE CUP
 2295;B;oplus;ISOAMSB;plus sign in circle # CIRCLED PLUS
 2296;B;ominus;ISOAMSB;minus sign in circle # CIRCLED MINUS
 2297;B;otimes;ISOAMSB;multiply sign in circle # CIRCLED TIMES
 2298;B;osol;ISOAMSB;solidus in circle # CIRCLED DIVISION SLASH
 2299;B;odot;ISOAMSB;middle dot in circle # CIRCLED DOT OPERATOR
 229A;B;ocir;ISOAMSB;small circle in circle # CIRCLED RING OPERATOR
 229B;B;oast;ISOAMSB;asterisk in circle # CIRCLED ASTERISK OPERATOR
 229C;B;oeq;equal in circle # CIRCLED EQUALS
 229D;B;odash;ISOAMSB;hyphen in circle # CIRCLED DASH
 229E;B;plusb;ISOAMSB;plus sign in box # SQUARED PLUS
 229F;B;minusb;ISOAMSB;minus sign in box # SQUARED MINUS
 22A0;B;timesb;ISOAMSB;multiply sign in box # SQUARED TIMES
 22A1;B;sdbar;ISOAMSB;/dotsquare /boxdot small dot in box # SQUARED DOT OPERATOR
 22A2;R;vdash;ISOAMSR;vertical, dash # RIGHT TACK
 22A3;R;dashv;ISOAMSR;dash, vertical # LEFT TACK
 22A4;N;top;ISOTECH;top # DOWN TACK
 22A5;R;perp;ISOTECH;perpendicular # UP TACK
 22A5;N;bottom;ISOTECH;bottom # UP TACK
 22A6;R;;;(vertical, short dash) # ASSERTION
 22A7;R;models;ISOAMSR;(vertical, short double dash) # MODELS
 22A8;R;VDash;ISOAMSR;vertical, double dash # TRUE
 22A9;R;Vdash;ISOAMSR;double vertical, dash # FORCES
 22AA;R;Vvdash;ISOAMSR;triple vertical, dash # TRIPLE VERTICAL BAR RIGHT TURNSTILE
 22AB;R;VDash;ISOAMSR;double vert, double dash # DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE
 22AC;R;nvdash;ISOAMSN;not vertical, dash # DOES NOT PROVE
 22AD;R;nVDash;ISOAMSN;not vertical, double dash # NOT TRUE
 22AE;R;nVdash;ISOAMSN;not double vertical, dash # DOES NOT FORCE
 22AF;R;nVDash;ISOAMSN;not double vert, double dash # NEGATED DOUBLE VERTICAL BAR DOUBLE RIGHT TURNSTILE
 22B0;R;prurel;ISOAMSR;element precedes under relation # PRECEDES UNDER RELATION
 22B1;R;scurel;; # SUCCEEDS UNDER RELATION
 22B2;R;vltri;ISOAMSR;left triangle, open, variant # NORMAL SUBGROUP OF

NORMAL SUBGROUP
 22B4;R;ltri;ISOAMSR;left triangle, equals # NORMAL SUBGROUP OF OR EQUAL TO
 22B5;R;rtri;ISOAMSR;right triangle, equals # CONTAINS AS NORMAL SUBGROUP OF OR EQUAL TO
 22B6;R;origof;ISOAMSR; # ORIGINAL OF
 22B7;R;imof;ISOAMSA; # IMAGE OF
 22B8;R;mumap;ISOAMSA;/multimap # MULTIMAP
 22B9;R;hercon;ISOAMSB; # HERMITIAN CONJUGATE MATRIX
 22BA;B;intcal;ISOAMSB;intercal # INTERCALATE
 22BB;B;;;logical or, bar below (large vee), exclusive disjunction # XOR
 22BC;B;;;bar, wedge (large wedge) # NAND
 22BD;B;;;bar, vee (large vee) # NOR
 22BE;N;angrtvb;ISOAMSO;right angle-measured [with arc]# RIGHT ANGLE WITH ARC
 22BF;N;;; # RIGHT TRIANGLE
 22C0;L;xwedge;ISOAMSB;logical or operator # N-ARY LOGICAL AND
 22C1;L;xvee;ISOAMSB;logical and operator # N-ARY LOGICAL OR
 22C2;L;xcap;ISOAMSB;intersection operator # N-ARY INTERSECTION
 22C3;L;xcup;ISOAMSB;union operator # N-ARY UNION
 22C4;B;diam;ISOAMSB;white diamond # DIAMOND OPERATOR
 22C5;B;sdot;ISOAMSB;small middle dot # DOT OPERATOR
 22C6;B;ssstarf;ISOAMSB;small star, filled, low # STAR OPERATOR
 22C7;B;divonx;ISOAMSB;division on times # DIVISION TIMES
 22C8;R;bowtie;ISOAMSR; # BOWTIE
 22C9;B;ltimes;ISOAMSB;times sign, left closed # LEFT NORMAL FACTOR SEMIDIRECT PRODUCT
 22CA;B;rtimes;ISOAMSB;times sign, right closed # RIGHT NORMAL FACTOR SEMIDIRECT PRODUCT
 22CB;B;lthre;ISOAMSB; # LEFT SEMIDIRECT PRODUCT
 22CC;B;rthre;ISOAMSB; # RIGHT SEMIDIRECT PRODUCT
 22CD;R;bsime;ISOAMSR;reverse similar, equals # REVERSE TILDE EQUALS
 22CE;B;cuvee;ISOAMSB; # CURLY LOGICAL OR
 22CF;B;cuwed;ISOAMSB; # CURLY LOGICAL AND
 22D0;R;Sub;ISOAMSR; # DOUBLE SUBSET
 22D1;R;Sup;ISOAMSR; # DOUBLE SUPERSET
 22D2;B;Cap;ISOAMSB;/Cap /doublecap # DOUBLE INTERSECTION
 22D3;B;Cup;ISOAMSB;/Cup /doublecup # DOUBLE UNION
 22D4;R;fork;ISOAMSR; # PITCHFORK
 22D5;R;epar;ISOTECH;parallel, equal # EQUAL AND PARALLEL TO
 22D6;R;ltdot;ISOAMSR; # LESS THAN WITH DOT
 22D7;R;gtdot;ISOAMSR; # GREATER THAN WITH DOT
 22D8;R;Ll;ISOAMSR;/Ll /lll /lless triple less-than # VERY MUCH LESS-THAN
 22D9;R;Gg;ISOAMSR;/ggg /Gg /gggtr triple greater-than # VERRY MUCH GREATER-THAN
 22DA;R;leg;ISOAMSR;less, equals, greater # LESS-THAN EQUAL TO OR GREATER-THAN
 22DB;R;gel;ISOAMSR;greater, equals, less # GREATER-THAN EQUAL TO OR LESS-THAN
 22DC;R;el;ISOAMSR;equal-or-less # EQUAL TO OR LESS-THAN
 22DD;R;eg;ISOAMSR;equal-or-greater # EQUAL TO OR GREATER-THAN
 22DE;R;cuepr;ISOAMSR;curly equals, precedes # EQUAL TO OR PRECEDES
 22DF;R;cuesc;ISOAMSR;curly equals, succeeds # EQUAL TO OR SUCCEEDS
 22E0;R;nprcue;ISOAMSN;not precedes, curly equals # DOES NOT PRECEDE OR EQUAL
 22E1;R;nscue;ISOAMSN;not succeeds, curly equals # DOES NOT SUCCEED OR EQUAL
 22E2;R;nsqsube;ISOAMSN;not, square subset, equals # NOT SQUARE IMAGE OF OR EQUAL TO
 22E3;R;nsqsupe;ISOAMSN;not, square superset, equals # NOT SQUARE ORIGINAL OF OR EQUAL TO
 22E4;R;sqsubne;;square subset, not equals # SQUARE IMAGE OF OR NOT EQUAL TO
 22E5;R;sqsupne;;square superset, not equals # SQUARE ORIGINAL OF OR NOT EQUAL TO
 22E6;R;lnsim;ISOAMSN;less, not similar # LESS-THAN BUT NOT EQUIVALENT TO
 22E7;R;gnsim;ISOAMSN;greater, not similar # GREATER-THAN BUT NOT EQUIVALENT TO
 22E8;R;prnsim;ISOAMSN;precedes, not similar # PRECEDES BUT

22E8;R;prnsim;ISOAMSN;precedes, not similar # PRECEDES BUT NOT EQUIVALENT TO
 22E9;R;scnsim;ISOAMSN;succeeds, not similar # SUCCEEDS BUT NOT EQUIVALENT TO
 22EA;R;nlttri;ISOAMSN;not left triangle # NOT NORMAL SUBGROUP OF
 22EB;R;nrttri;ISOAMSN;not right triangle # DOES NOT CONTAIN AS NORMAL SUBGROUP
 22EC;R;nlttri;ISOAMSN;not left triangle, equals # NOT NORMAL SUBGROUP OF OR EQUAL TO
 22ED;R;nrttri;ISOAMSN;not right triangle, equals # DOES NOT CONTAIN AS NORMAL SUBGROUP OR EQUAL
 22EE;R;vellip;ISOPUB;vertical ellipsis # VERTICAL ELLIPSIS
 22EF;R;ctdot;ISOTECH;three dots, centered # MIDLINE HORIZONTAL ELLIPSIS
 22F0;R;utdot;ISOTECH;three dots, ascending # UP RIGHT DIAGONAL ELLIPSIS
 22F1;R;dtdot;ISOTECH;three dots, descending # DOWN RIGHT DIAGONAL ELLIPSIS
 22F2;R;disin;ISOTECH; # ELEMENT OF WITH LONG HORIZONTAL STROKE
 22F3;R;isinsv;ISOTECH; # ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
 22F4;R;isins;ISOTECH; # SMALL ELEMENT OF WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
 22F5;R;isindot;ISOTECH; # ELEMENT OF WITH DOT ABOVE
 22F6;R;notinvc;ISOTECH; # ELEMENT OF WITH OVERBAR
 22F7;R;notinvb;ISOTECH; # SMALL ELEMENT OF WITH OVERBAR
 22F8;R;isinvb;; # ELEMENT OF WITH UNDERBAR
 22F9;R;isinE;ISOTECH; # ELEMENT OF WITH TWO HORIZONTAL STROKES
 22FA;R;nisd;ISOTECH; # CONTAINS WITH LONG HORIZONTAL STROKE
 22FB;R;xnis;ISOTECH; # CONTAINS WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
 22FC;R;nis;ISOTECH; # SMALL CONTAINS WITH VERTICAL BAR AT END OF HORIZONTAL STROKE
 22FD;R;notnvc;ISOTECH; # CONTAINS WITH OVERBAR
 22FE;R;notnib;ISOTECH; # SMALL CONTAINS WITH OVERBAR
 22FF;R;;; # Z NOTATION BAG MEMBERSHIP
 2300;N;diameter;;2205 diameter sign # DIAMETER SIGN
 2302;N;;; # HOUSE
 2305;B;barwed;ISOAMSB;/barwedge logical and, bar above [projective (bar over small wedge)] # PROJECTIVE
 2306;B;Barwed;ISOAMSB;/doublebarwedge logical and, double bar above [perspective (double bar over small wedge)] # PERSPECTIVE
 2308;O;lceil;ISOAMSC; # LEFT CEILING
 2309;C;rceil;ISOAMSC; # RIGHT CEILING
 230A;O;lfloor;ISOAMSC; # LEFT FLOOR
 230B;C;rfloor;ISOAMSC; # RIGHT FLOOR
 2310;N;bnot;ISOTECH; # REVERSED NOT SIGN
 2311;N;;; # SQUARE LOZENGE
 2319;N;;; # TURNED NOT SIGN
 231C;O;ulcorn;ISOAMSC; # TOP LEFT CORNER
 231D;C;urcorn;ISOAMSC; # TOP RIGHT CORNER
 231E;O;dlcorn;ISOAMSC; # BOTTOM LEFT CORNER
 231F;C;drcorn;ISOAMSC; # BOTTOM RIGHT CORNER
 2322;R;frown;ISOAMSR;down curve # FROWN
 2323;R;smile;ISOAMSR;up curve # SMILE
 2329;O;;;left angle bracket (deprecated for math use, use 27E8) # LEFT-POINTING ANGLE BRACKET
 232A;C;;;right angle bracket (deprecated for math use, use 27E9) # RIGHT-POINTING ANGLE BRACKET
 2336;N;topbot;ISOTECH;top and bottom # APL FUNCTIONAL SYMBOL I-BEAM
 233D;B;ovbar;ISOAMSB;circle with vertical bar # APL FUNCTIONAL SYMBOL CIRCLE STILE
 233F;R;solbar;ISOAMSN;solidus, bar through # APL FUNCTIONAL SYMBOL SLASH BAR
 2394;N;hbenzen;ISOICHEM;horizontal benzene ring [hexagon flat open] # SOFTWARE-FUNCTION SYMBOL
 23B0;R;loust;ISOAMSC; # UPPER LEFT OR LOWER RIGHT CURLY BRACKET SECTION
 23B1;R;rmost;ISOAMSC; # UPPER RIGHT OR LOWER LEFT CURLY BRACKET SECTION
 23B4;N;tbrk;ISOAMSO; # TOP SQUARE BRACKET
 23B5;N;bbrk;ISOAMSO; # BOTTOM SQUARE BRACKET
 23B6;N;bbrktbrk;ISOAMSO; # BOTTOM SQUARE BRACKET OVER

23B6;N;bbrktbrk;ISOAMSO; # BOTTOM SQUARE BRACKET OVER TOP SQUARE BRACKET
 2460..02468;N;;; # CIRCLED DIGIT ONE..NINE
 24B6..024C7;N;;; # CIRCLED LATIN CAPITAL LETTER A..R
 24C8;N;oS;ISOAMSO;capital S in circle # CIRCLED LATIN CAPITAL LETTER S
 24C9..024E9;N;;; # CIRCLED LATIN CAPITAL LETTER T..SMALL LETTER Z
 24EA;N;;; # CIRCLED DIGIT ZERO
 25A0;N;squarf;ISOPUB;square, filled # BLACK SQAURE
 25A1;N;square;ISOPUB;square, open # WHITE SQUARE
 25AA;N;squf;ISOPUB;? /blacksquare - sq bullet, filled # BLACK SMALL SQUARE
 25AB;N;;; # WHITE SMALL SQUARE
 25AD;N;;;horizontal rectangle, open # WHITE RECTANGLE
 25AE;N;marker;ISOPUB;histogram marker # BLACK VERTICAL RECTANGLE
 25AF;N;rect;ISOPUB; # WHITE VERTICAL RECTANGLE
 25B1;N;;;parallelogram, open # WHITE PARALLELLOGRAM
 25B2;B;;; # BLACK UP-POINTING TRIANGLE
 25B3;B;xutri;ISOAMSB;big up triangle, open # BLACK UP-POINTING TRIANGLE
 25B4;B;utrif;ISOPUB;up triangle, filled # BLACK UP-POINTING SMALL TRIANGLE
 25B5;B;utri;ISOPUB;/triangle - up triangle, open # WHITE UP-POINTING TRIANGLE
 25B6;B;vrtrif;;(large) right triangle, filled # BLACK RIGHT-POINTING TRIANGLE
 25B7;B;vrtri;;(large) right triangle, open, Z notation range restriction # WHITE RIGHT-POINTING TRIANGLE
 25B8;B;rtrif;ISOPUB;right triangle, filled # BLACK RIGHT-POINTING SMALL TRIANGLE
 25B9;B;rtri;ISOPUB;right triangle, open # WHITE RIGHT-POINTING SMALL TRIANGLE
 25BC;B;;;big down triangle, filled # BLACK DOWN-POINTING TRIANGLE
 25BD;B;xdtri;ISOAMSB;big down triangle, open # WHITE DOWN-POINTING TRIANGLE
 25BE;B;dtrif;ISOPUB;down triangle, filled # BLACK DOWN-POINTING SMALL TRIANGLE
 25BF;B;dtri;ISOPUB;down triangle, open # WHITE DOWN-POINTING SMALL TRIANGLE
 25C0;B;vltrif;;(large) left triangle, filled # BLACK LEFT-POINTING TRIANGLE
 25C1;B;vltri;;(large) left triangle, open, Z notation domain restriction # WHITE LEFT-POINTING TRIANGLE
 25C2;B;ltrif;ISOPUB;left triangle, filled # BLACK LEFT-POINTING SMALL TRIANGLE
 25C3;B;ltri;ISOPUB;left triangle, open # WHITE LEFT-POINTING SMALL TRIANGLE
 25C4;B;;; # BLACK LEFT-POINTING POINTER
 25C5;B;;; # WHITE LEFT-POINTING POINTER
 25C6;N;diamonf;ISOPUB; # BLACK DIAMOND
 25C7;N;;; # WHITE DIAMOND
 25C8;N;;; # WHITE DIAMOND CONTAINING BLACK SMALL DIAMOND
 25C9;N;;; # FISHEYE
 25CA;B;loz;ISOPUB;lozenge or total mark # LOZENGE
 25CB;B;xcirc;ISOAMSB;large circle # WHITE CIRCLE
 25CE;N;;; # BULLSEYE
 25CF;N;circlef;ISOPUB;circle, filled # BLACK CIRCLE
 25D6;N;;; # LEFT HALF BLACK CIRCLE
 25D7;N;;; # RIGHT HALF BLACK CIRCLE
 25E2;N;ltrif;;lower right triangle, filled # BLACK LOWER RIGHT TRIANGLE
 25E3;N;lltrif;;lower left triangle, filled # BLACK LOWER LEFT TRIANGLE
 25E4;N;ultrif;;upper left triangle, filled # BLACK UPPER LEFT TRIANGLE
 25E5;N;urtrif;;upper right triangle, filled # BLACK UPPER RIGHT TRIANGLE
 25E6;B;;; # WHITE BULLET
 25EB;B;midb;;vertical bar in box # WHITE SQUARE WITH VERTICAL BISECTING LINE
 25EC;B;tridot;ISOAMSB;triangle with centered dot # WHITE UP-POINTING TRIANGLE WITH DOT
 25EF;N;;; # LARGE CIRCLE
 25F8;B;ultri;ISOAMSO; # UPPER LEFT TRIANGLE

25F9;B;urtri;ISOAMSO; # UPPER RIGHT TRIANGLE
 25FA;B;lltri;ISOAMSO; # LOWER LEFT TRIANGLE
 25FB;B;xsqu;; # WHITE MEDIUM SQUARE
 25FC;B;xsquf;; # BLACK MEDIUM SQUARE
 25FD;B;vssqu;; # WHITE MEDIUM SMALL SQUARE
 25FE;B;vssquf;; # BLACK MEDIUM SMALL SQUARE
 25FF;B;ltri;ISOAMSO; # LOWER RIGHT TRIANGLE
 2605;B;starf;ISOPUB;star, filled # BLACK STAR
 2606;B;star;ISOPUB;star, open # WHITE STAR
 2609;N;;; # SUN
 260C;N;;; # CONJUNCTION
 2612;N;cross;ISOPUB;ballot cross # BALLOT BOX WITH X
 263D;N;;; # FIRST QUARTER MOON
 263E;N;;; # LAST QUARTER MOON
 263F;N;;; # MERCURY
 2640;N;female;ISOPUB;Venus # FEMALE SIGN
 2641;N;;; # EARTH
 2642;N;male;ISOPUB;Mars # MALE SIGN
 2643;N;;; # JUPITER
 2644;N;;; # SATURN
 2646;N;;; # NEPTUNE
 2647;N;;; # PLUTO
 2648;N;;; # ARIES
 2649;N;;; # TAURUS
 2660;N;spades;ISOPUB;spades suit symbol # BLACK SPADE SUIT
 2661;N;hearts;ISOPUB;heart suit symbol # WHITE HEART SUIT
 2662;N;diams;ISOPUB;diamond suit symbol # WHITE DIAMOND SUIT
 2663;N;clubs;ISOPUB;club suit symbol # BLACK CLUB SUIT
 2664;N;spadeso;;spade, white (card suit) # WHITE SPADE SUIT
 2665;N;heartsf;;filled heart (card suit) # BLACK HEART SUIT
 2666;N;diamsf;;filled diamond (card suit) # BLACK DIAMOND SUIT
 2667;N;clubso;;club, white (card suit) # WHITE CLUB SUIT
 2669;N;sung;ISONUM;music note (sung text sign) # QUARTER NOTE
 266D;N;flat;ISOPUB; # MUSIC FLAT SIGN
 266E;N;natur;ISOPUB; # MUSIC NATURAL SIGN
 266F;N;sharp;ISOPUB; # MUSIC SHARP SIGN
 2680;N;;; # DIE FACE-1
 2681;N;;; # DIE FACE-2
 2682;N;;; # DIE FACE-3
 2683;N;;; # DIE FACE-4
 2684;N;;; # DIE FACE-5
 2685;N;;; # DIE FACE-6
 2686;N;;; # WHITE CIRCLE WITH DOT RIGHT
 2687;N;;; # WHITE CIRCLE WITH TWO DOTS
 2688;N;;; # BLACK CIRCLE WITH WHITE DOT RIGHT
 2689;N;;; # BLACK CIRCLE WITH TWO WHITE DOTS
 2713;N;check;ISOPUB;tick # CHECK MARK
 2720;N;malt;ISOPUB; # MALTESE CROSS
 272A;N;;; # CIRCLED WHITE STAR
 2736;N;;; # SIX POINTED BLACK STAR
 2772;O;;; # LIGHT LEFT TORTOISE SHELL BRACKET ORNAMENT
 2773;C;;; # LIGHT RIGHT TORTOISE SHELL BRACKET ORNAMENT
 27D0;N;diamdot;; # WHITE DIAMOND WITH CENTRED DOT
 27D1;B;;; # AND WITH DOT
 27D2;R;;; # ELEMENT OF OPENING UPWARDS
 27D3;R;;; # LOWER RIGHT CORNER WITH DOT
 27D4;R;;; # UPPER LEFT CORNER WITH DOT
 27D5;L;;; # LEFT OUTER JOIN
 27D6;L;;; # RIGHT OUTER JOIN
 27D7;L;;; # FULL OUTER JOIN
 27D8;L;;; # LARGE UP TACK
 27D9;L;;; # LARGE DOWN TACK
 27DA;R;;; # LEFT AND RIGHT DOUBLE TURNSTILE
 27DB;R;;; # LEFT AND RIGHT TACK
 27DC;R;;; # LEFT MULTIMAP
 27DD;R;;; # LONG LEFT TACK
 27DE;R;;; # LONG RIGHT TACK
 27DF;R;;; # UP TACK WITH CIRCLE ABOVE
 27E0;B;;; # LOZENGE DIVIDED BY HORIZONTAL RULE
 27E1;B;;; # WHITE CONCAVE-SIDED DIAMOND
 27E2;B;;; # WHITE CONCAVE-SIDED DIAMOND WITH LEFTWARDS TICK
 27E3;B;;; # WHITE CONCAVE-SIDED DIAMOND WITH RIGHTWARDS TICK
 27E4;B;;; # WHITE SQUARE WITH LEFTWARDS TICK
 27E5;B;;; # WHITE SQUARE DIAMOND WITH RIGHTWARDS TICK

BRACKET
 27E7;C;robrk;ISOTECH;; # MATHEMATICAL RIGHT WHITE SQUARE BRACKET
 27E8;O;lang;ISOTECH;; # MATHEMATICAL LEFT ANGLE BRACKET
 27E9;C;rang;ISOTECH;; # MATHEMATICAL RIGHT ANGLE BRACKET
 27EA;O;Lang;ISOTECH;left angle bracket, double # MATHEMATICAL LEFT DOUBLE ANGLE BRACKET
 27EB;C;Rang;ISOTECH;right angle bracket, double # MATHEMATICAL RIGHT DOUBLE ANGLE BRACKET
 27F0;R;;; # UPWARDS QUADRUPLE ARROW
 27F1;R;;; # DOWNWARDS QUADRUPLE ARROW
 27F2;R;;; # ANTICLOCKWISE GAPPED CIRCLE ARROW
 27F3;R;;; # CLOCKWISE GAPPED CIRCLE ARROW
 27F4;R;;; # RIGHT ARROW WITH CIRCLE PLUS
 27F5;R;xlarr;ISOAMSA; # LONG LEFTWARDS ARROW
 27F6;R;xrarr;ISOAMSA; # LONG RIGHTWARDS ARROW
 27F7;R;xharr;ISOAMSA; # LONG LEFT RIGHT ARROW
 27F8;R;xlArr;ISOAMSA; # LONG LEFTWARDS DOUBLE ARROW
 27F9;R;xrArr;ISOAMSA; # LONG RIGHTWARDS DOUBLE ARROW
 27FA;R;xhArr;ISOAMSA; # LONG LEFT RIGHT DOUBLE ARROW
 27FB;R;xmapfrom;; # LONG LEFTWARDS ARROW FROM BAR
 27FC;R;xmap;ISOAMSA; # LONG RIGHTWARDS ARROW FROM BAR
 27FD;R;xMapfrom;; # LONG LEFTWARDS DOUBLE ARROW FROM BAR
 27FE;R;xMapto;; # LONG RIGHTWARDS DOUBLE ARROW FROM BAR
 27FF;R;xzigrarr;ISOAMSA; # LONG RIGHTWARDS ZIG-ZAG ARROW
 2900;R;;; # RIGHTWARDS TWO-HEADED ARROW WITH VERTICAL STROKE
 2901;R;;; # RIGHTWARDS TWO-HEADED ARROW WITH DOUBLE VERTICAL STROKE
 2902;R;nvlArr;ISOAMSA; # LEFTWARDS DOUBLE ARROW WITH VERTICAL STROKE
 2903;R;nvrArr;ISOAMSA; # RIGHTWARDS DOUBLE ARROW WITH VERTICAL STROKE
 2904;R;nvhArr;ISOAMSA; # LEFT RIGHT DOUBLE ARROW WITH VERTICAL STROKE
 2905;R;Map;ISOAMSA; # RIGHTWARDS TWO-HEADED ARROW FROM BAR
 2906;R;Mapfrom;; # LEFTWARDS DOUBLE ARROW FROM BAR
 2907;R;Mapto;; # RIGHTWARDS DOUBLE ARROW FROM BAR
 2908;R;darrln;; # DOWNWARDS ARROW WITH HORIZONTAL STROKE
 2909;R;uarrln;; # UPWARDS ARROW WITH HORIZONTAL STROKE
 290A;R;uAarr;; # UPWARDS TRIPLE ARROW
 290B;R;dAarr;; # DOWNWARDS TRIPLE ARROW
 290C;R;lbarr;ISOAMSA; # LEFTWARDS DOUBLE DASH ARROW
 290D;R;rbarr;ISOAMSA; # RIGHTWARDS DOUBLE DASH ARROW
 290E;R;lBarr;ISOAMSA; # LEFTWARDS TRIPLE DASH ARROW
 290F;R;rBarr;ISOAMSA; # RIGHTWARDS TRIPLE DASH ARROW
 2910;R;RBarr;ISOAMSA; # RIGHTWARDS TWO-HEADED TRIPLE DASH ARROW
 2911;R;DDottrahd;ISOAMSA; # RIGHTWARDS ARROW WITH DOTTED STEM
 2912;R;uarrb;; # UPWARDS ARROW TO BAR
 2913;R;darrb;; # DOWNWARDS ARROW TO BAR
 2914;R;;; # RIGHTWARDS ARROW WITH TAIL WITH VERTICAL STROKE
 2915;R;;; # RIGHTWARDS ARROW WITH TAIL WITH DOUBLE VERTICAL STROKE
 2916;R;Rarrtl;ISOAMSA; # RIGHTWARDS TWO-HEADED ARROW WITH TAIL
 2917;R;;; # RIGHTWARDS TWO-HEADED ARROW WITH TAIL WITH VERTICAL STROKE
 2918;R;;; # RIGHTWARDS TWO-HEADED ARROW WITH TAIL WITH DOUBLE VERTICAL STROKE
 2919;R;latail;ISOAMSA; # LEFTWARDS ARROW-TAIL
 291A;R;ratail;ISOAMSA; # RIGHTWARDS ARROW-TAIL
 291B;R;lAtail;ISOAMSA; # LEFTWARDS DOUBLE ARROW-TAIL
 291C;R;rAtail;ISOAMSA; # RIGHTWARDS DOUBLE ARROW-TAIL
 291D;R;larrfs;ISOAMSA; # LEFTWARDS ARROW TO BLACK DIAMOND
 291E;R;rarrfs;ISOAMSA; # RIGHTWARDS ARROW TO BLACK DIAMOND
 291F;R;larrbfs;ISOAMSA; # LEFTWARDS ARROW FROM BAR TO BLACK DIAMOND
 2920;R;rarrbfs;ISOAMSA; # RIGHTWARDS ARROW FROM BAR TO BLACK DIAMOND

2921;R;nwsesarr;; # NORTH WEST AND SOUTH EAST ARROW
 2922;R;neswsarr;; # NORTH EAST AND SOUTH WEST ARROW
 2923;R;nwarhk;ISOAMSA; # NORTH WEST ARROW WITH HOOK
 2924;R;nearhk;ISOAMSA; # NORTH EAST ARROW WITH HOOK
 2925;R;searhk;ISOAMSA; # SOUTH EAST ARROW WITH HOOK
 2926;R;swarhk;ISOAMSA; # SOUTH WEST ARROW WITH HOOK
 2927;R;nwnear;ISOAMSA; # NORTH WEST ARROW AND NORTH EAST ARROW
 2928;R;nesear;ISOAMSA; # NORTH EAST ARROW AND SOUTH EAST ARROW
 2929;R;seswar;ISOAMSA; # SOUTH EAST ARROW AND SOUTH WEST ARROW
 292A;R;swnwar;ISOAMSA; # SOUTH WEST ARROW AND NORTH WEST ARROW
 292B;R;rdiofdi;; # RISING DIAGONAL CROSSING FALLING DIAGONAL
 292C;R;fdiordi;; # FALLING DIAGONAL CROSSING RISING DIAGONAL
 292D;R;seonearr;; # SOUTH EAST ARROW CROSSING NORTH EAST ARROW
 292E;R;neosearr;; # NORTH EAST ARROW CROSSING SOUTH EAST ARROW
 292F;R;fdonearr;; # FALLING DIAGONAL CROSSING NORTH EAST ARROW
 2930;R;rdosearr;; # RISING DIAGONAL CROSSING SOUTH EAST ARROW
 2931;R;neonwarr;; # NORTH EAST ARROW CROSSING NORTH WEST ARROW
 2932;R;nwonearr;; # NORTH WEST ARROW CROSSING NORTH EAST ARROW
 2933;R;rarrc;ISOAMSA; # WAVE ARROW POINTING DIRECTLY RIGHT
 2934;R;;; # ARROW POINTING RIGHTWARDS THEN CURVING UPWARDS
 2935;R;;; # ARROW POINTING RIGHTWARDS THEN CURVING DOWNWARDS
 2936;R;ldca;ISOAMSA; # ARROW POINTING DOWNWARDS THEN CURVING LEFTWARDS
 2937;R;rdca;ISOAMSA; # ARROW POINTING DOWNWARDS THEN CURVING RIGHTWARDS
 2938;R;cudarrrl;ISOAMSA; # RIGHT-SIDE ARC CLOCKWISE ARROW
 2939;R;cudarrr;ISOAMSA; # LEFT-SIDE ARC ANTICLOCKWISE ARROW
 293A;R;;; # TOP ARC ANTICLOCKWISE ARROW
 293B;R;;; # BOTTOM ARC ANTICLOCKWISE ARROW
 293C;R;curarrm;ISOAMSA; # TOP ARC CLOCKWISE ARROW WITH MINUS
 293D;R;cularrp;ISOAMSA; # TOP ARC ANTICLOCKWISE ARROW WITH PLUS
 293E;R;;; # LOWER RIGHT SEMICIRCULAR CLOCKWISE ARROW
 293F;R;;; # LOWER LEFT SEMICIRCULAR ANTICLOCKWISE ARROW
 2940;R;olarr;ISOAMSA; # ANTICLOCKWISE CLOSED CIRCLE ARROW
 2941;R;orarr;ISOAMSA; # CLOCKWISE CLOSED CIRCLE ARROW
 2942;R;arrlrsl;; # RIGHTWARDS ARROW ABOVE SHORT LEFTWARDS ARROW
 2943;R;arrllsr;; # LEFTWARDS ARROW ABOVE SHORT RIGHTWARDS ARROW
 2944;R;arrsrll;; # SHORT RIGHTWARDS ARROW ABOVE LEFTWARDS ARROW
 2945;R;rarrpl;ISOAMSA; # RIGHTWARDS ARROW WITH PLUS BELOW
 2946;R;larrpl;ISOAMSA; # LEFTWARDS ARROW WITH PLUS BELOW
 2947;R;rarrx;; # RIGHTWARDS ARROW THROUGH X
 2948;R;harrcir;ISOAMSA; # LEFT RIGHT ARROW THROUGH SMALL CIRCLE
 2949;R;Uarrocir;ISOAMSA; # UPWARDS TWO-HEADED ARROW FROM SMALL CIRCLE
 294A;R;lurdshar;ISOAMSA; # LEFT BARB UP RIGHT BARB DOWN HARPOON
 294B;R;ldrushar;ISOAMSA; # LEFT BARB DOWN RIGHT BARB UP HARPOON
 294C;R;urdlshar;; # UP BARB RIGHT DOWN BARB LEFT HARPOON
 294D;R;uldrshar;; # UP BARB LEFT DOWN BARB RIGHT HARPOON
 294E;R;lurushar;; # LEFT BARB UP RIGHT BARB UP HARPOON
 294F;R;urdshar;; # UP BARB RIGHT DOWN BARB RIGHT HARPOON
 2950;R;ldrdshar;; # LEFT BARB DOWN RIGHT BARB DOWN

2950;R;ldrdshar;; # LEFT BARB DOWN RIGHT BARB DOWN HARPOON
 2951;R;uldshar;; # UP BARB LEFT DOWN BARB LEFT HARPOON
 2952;R;luharb;; # LEFTWARDS HARPOON WITH BARB UP TO BAR
 2953;R;ruharb;; # RIGHTWARDS HARPOON WITH BARB UP TO BAR
 2954;R;urharb;; # UPWARDS HARPOON WITH BARB RIGHT TO BAR
 2955;R;drrharb;; # DOWNWARDS HARPOON WITH BARB RIGHT TO BAR
 2956;R;ldharb;; # LEFTWARDS HARPOON WITH BARB DOWN TO BAR
 2957;R;rdharb;; # RIGHTWARDS HARPOON WITH BARB DOWN TO BAR
 2958;R;ulharb;; # UPWARDS HARPOON WITH BARB LEFT TO BAR
 2959;R;dlharb;; # DOWNWARDS HARPOON WITH BARB LEFT TO BAR
 295A;R;bluhar;; # LEFTWARDS HARPOON WITH BARB UP FROM BAR
 295B;R;bruhar;; # RIGHTWARDS HARPOON WITH BARB UP FROM BAR
 295C;R;burhar;; # UPWARDS HARPOON WITH BARB RIGHT FROM BAR
 295D;R;bdrhar;; # DOWNWARDS HARPOON WITH BARB RIGHT FROM BAR
 295E;R;bldhar;; # LEFTWARDS HARPOON WITH BARB DOWN FROM BAR
 295F;R;brdhar;; # RIGHTWARDS HARPOON WITH BARB DOWN FROM BAR
 2960;R;bulhar;; # UPWARDS HARPOON WITH BARB LEFT FROM BAR
 2961;R;bdlhar;; # DOWNWARDS HARPOON WITH BARB LEFT FROM BAR
 2962;R;lHar;ISOAMSA; # LEFTWARDS HARPOON WITH BARB UP ABOVE LEFTWARDS HARPOON WITH BARB DOWN
 2963;R;uHar;ISOAMSA; # UPWARDS HARPOON WITH BARB LEFT BESIDE UPWARDS HARPOON WITH BARB RIGHT
 2964;R;rHar;ISOAMSA; # RIGHTWARDS HARPOON WITH BARB UP ABOVE RIGHTWARDS HARPOON WITH BARB DOWN
 2965;R;dHar;ISOAMSA; # DOWNWARDS HARPOON WITH BARB LEFT BESIDE DOWNWARDS HARPOON WITH BARB RIGHT
 2966;R;luruHar;ISOAMSA; # LEFTWARDS HARPOON WITH BARB UP ABOVE RIGHTWARDS HARPOON WITH BARB UP
 2967;R;ldrdHar;ISOAMSA; # LEFTWARDS HARPOON WITH BARB DOWN ABOVE RIGHTWARDS HARPOON WITH BARB DOWN
 2968;R;ruluHar;ISOAMSA; # RIGHTWARDS HARPOON WITH BARB UP ABOVE LEFTWARDS HARPOON WITH BARB UP
 2969;R;rdldHar;ISOAMSA; # RIGHTWARDS HARPOON WITH BARB DOWN ABOVE LEFTWARDS HARPOON WITH BARB DOWN
 296A;R;lharul;ISOAMSA; # LEFTWARDS HARPOON WITH BARB UP ABOVE LONG DASH
 296B;R;llhard;ISOAMSA; # LEFTWARDS HARPOON WITH BARB DOWN BELOW LONG DASH
 296C;R;rharul;ISOAMSA; # RIGHTWARDS HARPOON WITH BARB UP ABOVE LONG DASH
 296D;R;lrhard;ISOAMSA; # RIGHTWARDS HARPOON WITH BARB DOWN BELOW LONG DASH
 296E;R;udhar;ISOAMSA; # UPWARDS HARPOON WITH BARB LEFT BESIDE DOWNWARDS HARPOON WITH BARB RIGHT
 296F;R;duhar;ISOAMSA; # DOWNWARDS HARPOON WITH BARB LEFT BESIDE UPWARDS HARPOON WITH BARB RIGHT
 2970;R;ringly;; # RIGHT DOUBLE ARROW WITH ROUNDED HEAD
 2971;R;erarr;ISOAMSA; # EQUALS SIGN ABOVE RIGHTWARDS ARROW
 2972;R;simrarr;ISOAMSA; # TILDE OPERATOR ABOVE RIGHTWARDS ARROW
 2973;R;larrsim;ISOAMSA; # LEFTWARDS ARROW ABOVE TILDE OPERATOR
 2974;R;rarrsim;ISOAMSA; # RIGHTWARDS ARROW ABOVE TILDE OPERATOR
 2975;R;rarrap;ISOAMSA; # RIGHTWARDS ARROW ABOVE ALMOST EQUAL TO
 2976;R;ltlarr;ISOAMSR; # LESS-THAN ABOVE LEFTWARDS ARROW
 2977;R;;; # LEFTWARDS ARROW THROUGH LESS-THAN
 2978;R;gtrarr;ISOAMSR; # GREATER-THAN ABOVE RIGHTWARDS ARROW
 2979;R;subrarr;ISOAMSR; # SUBSET ABOVE RIGHTWARDS ARROW
 297A;R;;; # LEFTWARDS ARROW THROUGH SUBSET
 297B;R;suplarr;ISOAMSR; # SUPerset ABOVE LEFTWARDS ARROW

297C;R;lfisht;ISOAMSA; # LEFT FISH TAIL
297D;R;rfisht;ISOAMSA; # RIGHT FISH TAIL
297E;R;ufisht;ISOAMSA; # UP FISH TAIL
297F;R;dfisht;ISOAMSA; # DOWN FISH TAIL
2980;F;tverbar;; # TRIPLE VERTICAL BAR DELIMITER
2981;N;scirclef;; # Z NOTATION SPOT
2982;F;;; # Z NOTATION TYPE COLON
2983;O;locub;; # LEFT WHITE CURLY BRACKET
2984;C;rocub;; # RIGHT WHITE CURLY BRACKET
2985;O;lopar;ISOTECH; # LEFT WHITE PARENTHESIS
2986;C;ropar;ISOTECH; # RIGHT WHITE PARENTHESIS
2987;O;;; # Z NOTATION LEFT IMAGE BRACKET
2988;C;;; # Z NOTATION RIGHT IMAGE BRACKET
2989;O;;; # Z NOTATION LEFT BINDING BRACKET
298A;C;;; # Z NOTATION RIGHT BINDING BRACKET
298B;O;lbrke;ISOAMSC; # LEFT SQUARE BRACKET WITH UNDERBAR
298C;C;rbrke;ISOAMSC; # RIGHT SQUARE BRACKET WITH UNDERBAR
298D;O;lbrkslu;ISOAMSC; # LEFT SQUARE BRACKET WITH TICK IN TOP CORNER
298E;C;rbrksld;ISOAMSC; # RIGHT SQUARE BRACKET WITH TICK IN BOTTOM CORNER
298F;O;lbrksld;ISOAMSC; # LEFT SQUARE BRACKET WITH TICK IN BOTTOM CORNER
2990;C;rbrkslu;ISOAMSC; # RIGHT SQUARE BRACKET WITH TICK IN TOP CORNER
2991;O;langd;ISOAMSC; # LEFT ANGLE BRACKET WITH DOT
2992;C;rangd;ISOAMSC; # RIGHT ANGLE BRACKET WITH DOT
2993;O;lparlt;ISOAMSC; # LEFT ARC LESS-THAN BRACKET
2994;C;rpargt;ISOAMSC; # RIGHT ARC GREATER-THAN BRACKET
2995;gtlPar;ISOAMSC; # DOUBLE LEFT ARC GREATER-THAN BRACKET
2996;ltrPar;ISOAMSC; # DOUBLE RIGHT ARC LESS-THAN BRACKET
2997;O;;; # LEFT BLACK TORTOISE SHELL BRACKET
2998;C;;; # RIGHT BLACK TORTOISE SHELL BRACKET
2999;F;vellip4;; # DOTTED FENCE
299A;F;vzigzag;ISOAMSO; # VERTICAL ZIGZAG LINE
299B;N;;; # MEASURED ANGLE OPENING LEFT
299C;N;vangrt;ISOTECH; # RIGHT ANGLE VARIANT WITH SQUARE
299D;N;angrtvbd;ISOAMSO; # MEASURED RIGHT ANGLE WITH DOT
299E;N;angles;; # ANGLE WITH S INSIDE
299F;N;angdnr;; # ACUTE ANGLE
29A0;N;gtlpar;; # SPHERICAL ANGLE OPENING LEFT
29A1;N;;; # SPHERICAL ANGLE OPENING UP
29A2;N;angdnl;; # TURNED ANGLE
29A3;N;angupl;; # REVERSED ANGLE
29A4;N;ange;ISOAMSO; # ANGLE WITH UNDERBAR
29A5;N;range;ISOAMSO; # REVERSED ANGLE WITH UNDERBAR
29A6;N;dwangle;ISOTECH; # OBLIQUE ANGLE OPENING UP
29A7;N;uwangle;ISOTECH; # OBLIQUE ANGLE OPENING DOWN
29A8;N;angmsdaa;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING UP AND RIGHT
29A9;N;angmsdab;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING UP AND LEFT
29AA;N;angmsdac;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING DOWN AND RIGHT
29AB;N;angmsdad;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING DOWN AND LEFT
29AC;N;angmsdae;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING RIGHT AND UP
29AD;N;angmsdaf;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING LEFT AND UP
29AE;N;angmsdag;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING RIGHT AND DOWN
29AF;N;angmsdah;ISOAMSO; # MEASURED ANGLE WITH OPEN ARM ENDING IN ARROW POINTING LEFT AND DOWN
29B0;N;bemptyv;ISOAMSO; # REVERSED EMPTY SET
29B1;N;demptyv;ISOAMSO; # EMPTY SET WITH OVERBAR
29B2;N;cemptyv;ISOAMSO; # EMPTY SET WITH SMALL CIRCLE ABOVE
29B3;N;raemptyv;ISOAMSO; # EMPTY SET WITH RIGHT ARROW ABOVE
29B4;N;laemptyv;ISOAMSO; # EMPTY SET WITH LEFT ARROW ABOVE
29B5;N;ohbar;ISOAMSB; # CIRCLE WITH HORIZONTAL BAR

29B6;B;omid;ISOAMSB; # CIRCLED VERTICAL BAR
29B7;B;opar;ISOAMSB; # CIRCLED PARALLEL
29B8;B;obsol;; # CIRCLED REVERSE SOLIDUS
29B9;B;operp;ISOAMSB; # CIRCLED PERPENDICULAR
29BA;N;;; # CIRCLE DIVIDED BY HORIZONTAL BAR AND TOP HALF DIVIDED BY VERTICAL BAR
29BB;N;olcross;ISOTECH; # CIRCLE WITH SUPERIMPOSED X
29BC;N;odsold;ISOAMSB; # CIRCLED ANTICLOCKWISE-ROTATED DIVISION SIGN
29BD;N;oxuarr;; # UP ARROW THROUGH CIRCLE
29BE;N;olcir;ISOAMSB; # CIRCLED WHITE BULLET
29BF;N;ofcir;ISOAMSB; # CIRCLED BULLET
29C0;B;olt;ISOAMSB; # CIRCLED LESS-THAN
29C1;B;ogt;ISOAMSB; # CIRCLED GREATER-THAN
29C2;N;cirscir;ISOAMSO; # CIRCLE WITH SMALL CIRCLE TO THE RIGHT
29C3;N;cirE;ISOAMSO; # CIRCLE WITH TWO HORIZONTAL STROKES TO THE RIGHT
29C4;B;solb;ISOAMSB; # SQUARED RISING DIAGONAL SLASH
29C5;B;bsolb;ISOAMSB; # SQUARED FALLING DIAGONAL SLASH
29C6;B;astb;; # SQUARED ASTERISK
29C7;B;cirb;; # SQUARED SMALL CIRCLE
29C8;B;squb;; # SQUARED SQUARE
29C9;N;boxbox;ISOAMSO; # TWO JOINED SQUARES
29CA;N;tridoto;; # TRIANGLE WITH DOT ABOVE
29CB;N;tribar;; # TRIANGLE WITH UNDERBAR
29CC;N;triS;; # S IN TRIANGLE
29CD;N;trisb;ISOAMSB; # TRIANGLE WITH SERIFS AT BOTTOM
29CE;R;triltri;ISOAMSR; # RIGHT TRIANGLE ABOVE LEFT TRIANGLE
29CF;R;ltrivb;; # LEFT TRIANGLE BESIDE VERTICAL BAR
29D0;R;vbrtri;; # VERTICAL BAR BESIDE RIGHT TRIANGLE
29D1;R;lfbowtie;; # LEFT BLACK BOWTIE
29D2;R;rfbowtie;; # RIGHT BLACK BOWTIE
29D3;R;fbowtie;; # BLACK BOWTIE
29D4;R;lftimes;; # LEFT BLACK TIMES
29D5;R;rftimes;; # RIGHT BLACK TIMES
29D6;B;hrglass;; # WHITE HOURGLASS
29D7;B;fhrglass;; # BLACK HOURGLASS
29D8;O;;; # LEFT WIGGLY FENCE
29D9;C;;; # RIGHT WIGGLY FENCE
29DA;O;;; # LEFT DOUBLE WIGGLY FENCE
29DB;C;;; # RIGHT DOUBLE WIGGLY FENCE
29DC;N;iinfin;ISOTECH; # INCOMPLETE INFINITY
29DD;N;infintie;ISOTECH; # TIE OVER INFINITY
29DE;N;nvinfin;ISOTECH; # INFINITY NEGATED WITH VERTICAL BAR
29DF;R;dumap;; # DOUBLE-ENDED MULTIMAP
29E0;N;dalembrr;; # SQUARE WITH CONTOURED OUTLINE
29E1;R;lrrreq;; # INCREASES AS
29E2;B;shuffle;; # SHUFFLE PRODUCT
29E3;R;eparsl;ISOTECH; # EQUALS SIGN AND SLANTED PARALLEL
29E4;R;smeparsl;ISOTECH; # EQUALS SIGN AND SLANTED PARALLEL WITH TILDE ABOVE
29E5;R;eqvparsl;ISOTECH; # IDENTICAL TO AND SLANTED PARALLEL
29E6;R;;; # GLEICH STARK
29E7;N;thermod;; # THERMODYNAMIC
29E8;N;dtrilf;; # DOWN-POINTING TRIANGLE WITH LEFT HALF BLACK
29E9;N;dtrirf;; # DOWN-POINTING TRIANGLE WITH RIGHT HALF BLACK
29EA;N;diamdarr;; # BLACK DIAMOND WITH DOWN ARROW
29EB;B;lozf;ISOPUB; # BLACK LOZENGE
29EC;N;cirdarr;; # WHITE CIRCLE WITH DOWN ARROW
29ED;N;cirfdarr;; # BLACK CIRCLE WITH DOWN ARROW
29EE;N;squerr;; # ERROR-BARRED WHITE SQUARE
29EF;N;squferr;; # ERROR-BARRED BLACK SQUARE
29F0;N;diamerr;; # ERROR-BARRED WHITE DIAMOND
29F1;N;diamerrf;; # ERROR-BARRED BLACK DIAMOND
29F2;N;cirerr;; # ERROR-BARRED WHITE CIRCLE
29F3;N;cirferr;; # ERROR-BARRED BLACK CIRCLE
29F4;R;;; # RULE-DELAYED
29F5;B;;; # REVERSE SOLIDUS OPERATOR
29F6;B;dsol;ISOTECH; # SOLIDUS WITH OVERBAR
29F7;B;rsolbar;; # REVERSE SOLIDUS WITH HORIZONTAL STROKE
29F8;L;xsol;; # BIG SOLIDUS
29F9;L;xbol;; # BIG REVERSE SOLIDUS

29FA;B;;; # DOUBLE PLUS
 29FB;B;;; # TRIPLE PLUS
 29FC;O;;; # LEFT POINTING CURVED ANGLE BRACKET
 29FD;C;;; # RIGHT POINTING CURVED ANGLE BRACKET
 29FE;B;;; # TINY
 29FF;B;;; # MINY
 2A00;L;xodot;ISOAMSB; # N-ARY CIRCLED DOT OPERATOR
 2A01;L;xoplus;ISOAMSB; # N-ARY CIRCLED PLUS OPERATOR
 2A02;L;xotime;ISOAMSB; # N-ARY CIRCLED TIMES OPERATOR
 2A03;L;xcupdot;; # N-ARY UNION OPERATOR WITH DOT
 2A04;L;xuplus;ISOAMSB; # N-ARY UNION OPERATOR WITH PLUS
 2A05;L;xsqcap;ISOAMSB; # N-ARY SQUARE INTERSECTION OPERATOR
 2A06;L;xsqcup;ISOAMSB; # N-ARY SQUARE UNION OPERATOR
 2A07;L;xandand;; # TWO LOGICAL AND OPERATOR
 2A08;L;xoror;; # TWO LOGICAL OR OPERATOR
 2A09;L;xtimes;; # N-ARY TIMES OPERATOR
 2A0A;B;;; # MODULO TWO SUM
 2A0B;L;sumint;; # SUMMATION WITH INTEGRAL
 2A0C;L;qint;ISOTECH; # QUADRUPLE INTEGRAL OPERATOR
 2A0D;L;fpartint;ISOTECH; # FINITE PART INTEGRAL
 2A0E;L;Barint;; # INTEGRAL WITH DOUBLE STROKE
 2A0F;L;slint;; # INTEGRAL AVERAGE WITH SLASH
 2A10;L;cirfnint;ISOTECH; # CIRCULATION FUNCTION
 2A11;L;awint;ISOTECH; # ANTICLOCKWISE INTEGRATION
 2A12;L;rppolint;ISOTECH; # LINE INTEGRATION WITH RECTANGULAR PATH AROUND POLE
 2A13;L;scpolint;ISOTECH; # LINE INTEGRATION WITH SEMICIRCULAR PATH AROUND POLE
 2A14;L;npolint;ISOTECH; # LINE INTEGRATION NOT INCLUDING THE POLE
 2A15;L;pointint;ISOTECH; # INTEGRAL AROUND A POINT OPERATOR
 2A16;L;quatint;ISOTECH; # QUATERNION INTEGRAL OPERATOR
 2A17;L;intlarhk;ISOTECH; # INTEGRAL WITH LEFTWARDS ARROW WITH HOOK
 2A18;L;timeint;; # INTEGRAL WITH TIMES SIGN
 2A19;L;capint;; # INTEGRAL WITH INTERSECTION
 2A1A;L;cupint;; # INTEGRAL WITH UNION
 2A1B;L;upint;; # INTEGRAL WITH OVERBAR
 2A1C;L;lowint;; # INTEGRAL WITH UNDERBAR
 2A1D;L;Join;; # JOIN
 2A1E;L;xltri;; # LARGE LEFT TRIANGLE OPERATOR
 2A1F;L;;; # Z NOTATION SCHEMA COMPOSITION
 2A20;L;;; # Z NOTATION SCHEMA PIPING
 2A21;L;;; # Z NOTATION SCHEMA PROJECTION
 2A22;B;pluscir;ISOAMSB; # PLUS SIGN WITH SMALL CIRCLE ABOVE
 2A23;B;plusacir;ISOAMSB; # PLUS SIGN WITH CIRCUMFLEX ACCENT ABOVE
 2A24;B;simplus;ISOAMSB; # PLUS SIGN WITH TILDE ABOVE
 2A25;B;plusdu;ISOAMSB; # PLUS SIGN WITH DOT BELOW
 2A26;B;plussim;ISOAMSB; # PLUS SIGN WITH TILDE BELOW
 2A27;B;plustwo;ISOAMSB; # PLUS SIGN WITH SUBSCRIPT TWO
 2A28;B;plustrif;; # PLUS SIGN WITH BLACK TRIANGLE
 2A29;B;mcomma;ISOAMSR; # MINUS SIGN WITH COMMA ABOVE
 2A2A;B;minusdu;ISOAMSB; # MINUS SIGN WITH DOT BELOW
 2A2B;B;;; # MINUS SIGN WITH FALLING DOTS
 2A2C;B;;; # MINUS SIGN WITH RISING DOTS
 2A2D;B;loplus;ISOAMSB; # PLUS SIGN IN LEFT HALF CIRCLE
 2A2E;B;roplus;ISOAMSB; # PLUS SIGN IN RIGHT HALF CIRCLE
 2A2F;B;htimes;; # VECTOR OR CROSS PRODUCT
 2A30;B;timesd;ISOAMSB; # MULTIPLICATION SIGN WITH DOT ABOVE
 2A31;B;timesbar;ISOAMSB; # MULTIPLICATION SIGN WITH UNDERBAR
 2A32;B;btimes;; # SEMIDIRECT PRODUCT WITH BOTTOM CLOSED
 2A33;B;smashp;ISOAMSB; # SMASH PRODUCT
 2A34;B;lotimes;ISOAMSB; # MULTIPLICATION SIGN IN LEFT HALF CIRCLE
 2A35;B;rotimes;ISOAMSB; # MULTIPLICATION SIGN IN RIGHT HALF CIRCLE
 2A36;B;otimesas;ISOAMSB; # CIRCLED MULTIPLICATION SIGN WITH CIRCUMFLEX ACCENT
 2A37;B;Otimes;ISOAMSB; # MULTIPLICATION SIGN IN DOUBLE CIRCLE
 2A38;B;odiv;ISOAMSB; # CIRCLED DIVISION SIGN
 2A39;B;triplus;ISOAMSB; # PLUS SIGN IN TRIANGLE

2A3A;B;trminus;ISOAMSB; # MINUS SIGN IN TRIANGLE
 2A3B;B;tritime;ISOAMSB; # MULTIPLICATION SIGN IN TRIANGLE
 2A3C;B;iproduct;ISOAMSB; # INTERIOR PRODUCT
 2A3D;B;iprodr;ISOAMSB; # RIGHTHAND INTERIOR PRODUCT
 2A3E;B;;; # Z NOTATION RELATIONAL COMPOSITION
 2A3F;B;amalg;ISOAMSB; # AMALGAMATION OR COPRODUCT
 2A40;B;capdot;ISOAMSB; # INTERSECTION WITH DOT
 2A41;B;;; # UNION WITH MINUS SIGN
 2A42;B;ncup;ISOAMSB; # UNION WITH OVERBAR
 2A43;B;ncap;ISOAMSB; # INTERSECTION WITH OVERBAR
 2A44;B;capand;ISOAMSB; # INTERSECTION WITH LOGICAL AND
 2A45;B;cupor;ISOAMSB; # UNION WITH LOGICAL OR
 2A46;B;cupcap;ISOAMSB; # UNION ABOVE INTERSECTION
 2A47;B;capcup;ISOAMSB; # INTERSECTION ABOVE UNION
 2A48;B;cupbrcap;ISOAMSB; # UNION ABOVE BAR ABOVE INTERSECTION
 2A49;B;capbrcup;ISOAMSB; # INTERSECTION ABOVE BAR ABOVE UNION
 2A4A;B;cupcup;ISOAMSB; # UNION BESIDE AND JOINED WITH UNION
 2A4B;B;capcap;ISOAMSB; # INTERSECTION BESIDE AND JOINED WITH INTERSECTION
 2A4C;B;ccups;ISOAMSB; # CLOSED UNION WITH SERIFS
 2A4D;B;ccaps;ISOAMSB; # CLOSED INTERSECTION WITH SERIFS
 2A4E;B;;; # DOUBLE SQUARE INTERSECTION
 2A4F;B;;; # DOUBLE SQUARE UNION
 2A50;B;ccupssm;ISOAMSB; # CLOSED UNION WITH SERIFS AND SMASH PRODUCT
 2A51;B;anddot;; # LOGICAL AND WITH DOT ABOVE
 2A52;B;ordot;; # LOGICAL OR WITH DOT ABOVE
 2A53;B;And;ISOTECH; # DOUBLE LOGICAL AND
 2A54;B;Or;ISOTECH; # DOUBLE LOGICAL OR
 2A55;B;andand;ISOTECH; # TWO INTERSECTING LOGICAL AND
 2A56;B;oror;ISOTECH; # TWO INTERSECTING LOGICAL OR
 2A57;B;orslope;ISOTECH; # SLOPING LARGE OR
 2A58;B;andslope;ISOTECH; # SLOPING LARGE AND
 2A59;R;;; # LOGICAL OR OVERLAPPING LOGICAL AND
 2A5A;B;andv;ISOTECH; # LOGICAL AND WITH MIDDLE STEM
 2A5B;B;orv;ISOTECH; # LOGICAL OR WITH MIDDLE STEM
 2A5C;B;andd;ISOTECH; # LOGICAL AND WITH HORIZONTAL DASH
 2A5D;B;ord;ISOTECH; # LOGICAL OR WITH HORIZONTAL DASH
 2A5E;B;Barwed;; # LOGICAL AND WITH DOUBLE OVERBAR
 2A5F;B;wedbar;ISOAMSB; # LOGICAL AND WITH UNDERBAR
 2A60;B;;; # LOGICAL AND WITH DOUBLE UNDERBAR
 2A61;B;veebar;ISOAMSB; # SMALL VEE WITH UNDERBAR
 2A62;B;;; # LOGICAL OR WITH DOUBLE OVERBAR
 2A63;B;veebar;; # LOGICAL OR WITH DOUBLE UNDERBAR
 2A64;B;;; # Z NOTATION DOMAIN ANTIRESTRICTION
 2A65;B;;; # Z NOTATION RANGE ANTIRESTRICTION
 2A66;R;sdote;ISOAMSR; # EQUALS SIGN WITH DOT BELOW
 2A67;R;;; # IDENTICAL WITH DOT ABOVE
 2A68;R;;; # TRIPLE HORIZONTAL BAR WITH DOUBLE VERTICAL STROKE
 2A69;R;;; # TRIPLE HORIZONTAL BAR WITH TRIPLE VERTICAL STROKE
 2A6A;R;simdot;ISOTECH; # TILDE OPERATOR WITH DOT ABOVE
 2A6B;R;;; # TILDE OPERATOR WITH RISING DOTS
 2A6C;R;;; # SIMILAR MINUS SIMILAR
 2A6D;R;congdot;ISOAMSR; # CONGRUENT WITH DOT ABOVE
 2A6E;R;easter;ISOAMSR; # EQUALS WITH ASTERISK
 2A6F;R;apacir;ISOTECH; # ALMOST EQUAL TO WITH CIRCUMFLEX ACCENT
 2A70;R;apE;ISOAMSR; # APPROXIMATELY EQUAL OR EQUAL TO
 2A71;B;eplus;ISOAMSB; # EQUALS SIGN ABOVE PLUS SIGN
 2A72;B;pluse;ISOAMSB; # PLUS SIGN ABOVE EQUALS SIGN
 2A73;R;Esim;ISOAMSR; # EQUALS SIGN ABOVE TILDE OPERATOR
 2A74;R;Colone;ISOAMSR; # DOUBLE COLON EQUAL
 2A75;R;eqeq;; # TWO CONSECUTIVE EQUALS SIGNS
 2A76;R;;; # THREE CONSECUTIVE EQUALS SIGNS
 2A77;R;eDDot;ISOAMSR; # EQUALS SIGN WITH TWO DOTS ABOVE AND TWO DOTS BELOW
 2A78;R;equivDD;ISOAMSR; # EQUIVALENT WITH FOUR DOTS ABOVE
 2A79;R;ltcir;ISOAMSR; # LESS-THAN WITH CIRCLE INSIDE
 2A7A;R;gtcir;ISOAMSR; # GREATER-THAN WITH CIRCLE INSIDE
 2A7B;R;ltquest;ISOAMSR; # LESS-THAN WITH QUESTION MARK ABOVE
 2A7C;R;gtquest;ISOAMSR; # GREATER-THAN WITH QUESTION

2A7C;R;gtquest;ISOAMSR; # GREATER-THAN WITH QUESTION MARK ABOVE
 2A7D;R;les;ISOAMSR; # LESS-THAN OR SLANTED EQUAL TO
 2A7E;R;ges;ISOAMSR; # GREATER-THAN OR SLANTED EQUAL TO
 2A7F;R;lesdot;ISOAMSR; # LESS-THAN OR SLANTED EQUAL TO WITH DOT INSIDE
 2A80;R;gesdot;ISOAMSR; # GREATER-THAN OR SLANTED EQUAL TO WITH DOT INSIDE
 2A81;R;lesdoto;ISOAMSR; # LESS-THAN OR SLANTED EQUAL TO WITH DOT ABOVE
 2A82;R;gesdoto;ISOAMSR; # GREATER-THAN OR SLANTED EQUAL TO WITH DOT ABOVE
 2A83;R;lesdotor;ISOAMSR; # LESS-THAN OR SLANTED EQUAL TO WITH DOT ABOVE RIGHT
 2A84;R;gesdotor;ISOAMSR; # GREATER-THAN OR SLANTED EQUAL TO WITH DOT ABOVE LEFT
 2A85;R;lapp;ISOAMSR; # LESS-THAN OR APPROXIMATE
 2A86;R;gap;ISOAMSR; # GREATER-THAN OR APPROXIMATE
 2A87;R;line;ISOAMSN; # LESS-THAN AND SINGLE-LINE NOT EQUAL TO
 2A88;R;gne;ISOAMSN; # GREATER-THAN AND SINGLE-LINE NOT EQUAL TO
 2A89;R;lnap;ISOAMSN; # LESS-THAN AND NOT APPROXIMATE
 2A8A;R;gnap;ISOAMSN; # GREATER-THAN AND NOT APPROXIMATE
 2A8B;R;lEg;ISOAMSR; # LESS-THAN ABOVE DOUBLE-LINE EQUAL ABOVE GREATER-THAN
 2A8C;R;gEl;ISOAMSR; # GREATER-THAN ABOVE DOUBLE-LINE EQUAL ABOVE LESS-THAN
 2A8D;R;lsime;ISOAMSR; # LESS-THAN ABOVE SIMILAR OR EQUAL
 2A8E;R;gsime;ISOAMSR; # GREATER-THAN ABOVE SIMILAR OR EQUAL
 2A8F;R;lsimg;ISOAMSR; # LESS-THAN ABOVE SIMILAR ABOVE GREATER-THAN
 2A90;R;gsiml;ISOAMSR; # GREATER-THAN ABOVE SIMILAR ABOVE LESS-THAN
 2A91;R;lge;ISOAMSR; # LESS-THAN ABOVE GREATER-THAN ABOVE DOUBLE-LINE EQUAL
 2A92;R;glE;ISOAMSR; # GREATER-THAN ABOVE LESS-THAN ABOVE DOUBLE-LINE EQUAL
 2A93;R;lesges;ISOAMSR; # LESS-THAN ABOVE SLANTED EQUAL ABOVE GREATER-THAN ABOVE SLANTED EQUAL
 2A94;R;gesles;ISOAMSR; # GREATER-THAN ABOVE SLANTED EQUAL ABOVE LESS-THAN ABOVE SLANTED EQUAL
 2A95;R;els;ISOAMSR; # SLANTED EQUAL TO OR LESS-THAN
 2A96;R;egs;ISOAMSR; # SLANTED EQUAL TO OR GREATER-THAN
 2A97;R;elsdot;ISOAMSR; # SLANTED EQUAL TO OR LESS-THAN WITH DOT INSIDE
 2A98;R;egsdot;ISOAMSR; # SLANTED EQUAL TO OR GREATER-THAN WITH DOT INSIDE
 2A99;R;;; # DOUBLE-LINE EQUAL TO OR LESS-THAN
 2A9A;R;;; # DOUBLE-LINE EQUAL TO OR GREATER-THAN
 2A9B;R;;; # DOUBLE-LINE SLANTED EQUAL TO OR LESS-THAN
 2A9C;R;;; # DOUBLE-LINE SLANTED EQUAL TO OR GREATER-THAN
 2A9D;R;siml;ISOAMSR; # SIMILAR OR LESS-THAN
 2A9E;R;simg;ISOAMSR; # SIMILAR OR GREATER-THAN
 2A9F;R;simlE;ISOAMSR; # SIMILAR ABOVE LESS-THAN ABOVE EQUALS SIGN
 2AA0;R;simgE;ISOAMSR; # SIMILAR ABOVE GREATER-THAN ABOVE EQUALS SIGN
 2AA1;R;Lt;ISOAMSR; # DOUBLE NESTED LESS-THAN
 2AA2;R;Gt;ISOAMSR; # DOUBLE NESTED GREATER-THAN
 2AA3;R;Ltbar;; # DOUBLE LESS-THAN WITH UNDERBAR
 2AA4;R;glj;ISOAMSR; # GREATER-THAN OVERLAPPING LESS-THAN
 2AA5;R;gla;ISOAMSR; # GREATER-THAN BESIDE LESS-THAN
 2AA6;R;ltcc;ISOAMSR; # LESS-THAN CLOSED BY CURVE
 2AA7;R;gtcc;ISOAMSR; # GREATER-THAN CLOSED BY CURVE
 2AA8;R;lesc;ISOAMSR; # LESS-THAN CLOSED BY CURVE ABOVE SLANTED EQUAL
 2AA9;R;gescc;ISOAMSR; # GREATER-THAN CLOSED BY CURVE ABOVE SLANTED EQUAL
 2AAA;R;smt;ISOAMSR; # SMALLER THAN
 2AAB;R;lat;ISOAMSR; # LARGER THAN
 2AAC;R;snte;ISOAMSR; # SMALLER THAN OR EQUAL TO
 2AAD;R;late;ISOAMSR; # LARGER THAN OR EQUAL TO
 2AAE;R;bumpE;ISOAMSR; # EQUALS SIGN WITH BUMPY ABOVE
 2AAF;R;pre;ISOAMSR; # PRECEDES ABOVE SINGLE-LINE EQUALS SIGN
 2AB0;R;sce;ISOAMSR; # SUCCEEDS ABOVE SINGLE-LINE EQUALS

SIGN
 2AB1;R;;; # PRECEDES ABOVE SINGLE-LINE NOT EQUAL TO
 2AB2;R;;; # SUCCEEDS ABOVE SINGLE-LINE NOT EQUAL TO
 2AB3;R;prE;ISOAMSR; # PRECEDES ABOVE EQUALS SIGN
 2AB4;R;scE;ISOAMSR; # SUCCEEDS ABOVE EQUALS SIGN
 2AB5;R;prnE;ISOAMSN; # PRECEDES ABOVE NOT EQUAL TO
 2AB6;R;scnE;ISOAMSNR; # SUCCEEDS ABOVE NOT EQUAL TO
 2AB7;R;prap;ISOAMSR; # PRECEDES ABOVE ALMOST EQUAL TO
 2AB8;R;scap;ISOAMSR; # SUCCEEDS ABOVE ALMOST EQUAL TO
 2AB9;R;prnap;ISOAMSN; # PRECEDES ABOVE NOT ALMOST EQUAL TO
 2ABA;R;scnap;ISOAMSN; # SUCCEEDS ABOVE NOT ALMOST EQUAL TO
 2ABB;R;Pr;ISOAMSR; # DOUBLE PRECEDES
 2ABC;R;Sc;ISOAMSR; # DOUBLE SUCCEEDS
 2ABD;R;subdot;ISOAMSB; # SUBSET WITH DOT
 2ABE;R;supdot;ISOAMSB; # SUPERSET WITH DOT
 2ABF;R;subplus;ISOAMSR; # SUBSET WITH PLUS SIGN BELOW
 2AC0;R;supplus;ISOAMSR; # SUPERSET WITH PLUS SIGN BELOW
 2AC1;R;submult;ISOAMSR; # SUBSET WITH MULTIPLICATION SIGN BELOW
 2AC2;R;supmult;ISOAMSR; # SUPERSET WITH MULTIPLICATION SIGN BELOW
 2AC3;R;subedot;ISOAMSR; # SUBSET OF OR EQUAL TO WITH DOT ABOVE
 2AC4;R;supedot;ISOAMSR; # SUPERSET OF OR EQUAL TO WITH DOT ABOVE
 2AC5;R;subE;ISOAMSR; # SUBSET OF ABOVE EQUALS SIGN
 2AC6;R;supE;ISOAMSR; # SUPERSET OF ABOVE EQUALS SIGN
 2AC7;R;subsim;ISOAMSR; # SUBSET OF ABOVE TILDE OPERATOR
 2AC8;R;supsim;ISOAMSR; # SUPERSET OF ABOVE TILDE OPERATOR
 2AC9;R;;; # SUBSET OF ABOVE ALMOST EQUAL TO
 2ACA;R;;; # SUPERSET OF ABOVE ALMOST EQUAL TO
 2ACB;R;subnE;ISOAMSN; # SUBSET OF ABOVE NOT EQUAL TO
 2ACC;R;supnE;ISOAMSN; # SUPERSET OF ABOVE NOT EQUAL TO
 2ACD;R;;; # SQUARE LEFT OPEN BOX OPERATOR
 2ACE;R;;; # SQUARE RIGHT OPEN BOX OPERATOR
 2ACF;R;csup;ISOAMSR; # CLOSED SUBSET
 2AD0;R;csup;ISOAMSR; # CLOSED SUPERSET
 2AD1;R;csupe;ISOAMSR; # CLOSED SUBSET OR EQUAL TO
 2AD2;R;csupe;ISOAMSR; # CLOSED SUPERSET OR EQUAL TO
 2AD3;R;subsup;ISOAMRS; # SUBSET ABOVE SUPERSET
 2AD4;R;supsub;ISOAMSR; # SUPERSET ABOVE SUBSET
 2AD5;R;subsub;ISOAMSR; # SUBSET ABOVE SUBSET
 2AD6;R;supsup;ISOAMSR; # SUPERSET ABOVE SUPERSET
 2AD7;R;suphsub;ISOAMSR; # SUPERSET BESIDE SUBSET
 2AD8;R;supdsub;ISOAMSR; # SUPERSET BESIDE AND JOINED BY DASH WITH SUBSET
 2AD9;R;forkv;ISOAMSR; # ELEMENT OF OPENING DOWNWARDS
 2ADA;R;topfork;ISOAMSR; # PITCHFORK WITH TEE TOP
 2ADB;R;mlcp;ISOAMSR; # TRANSVERSAL INTERSECTION
 2ADC;R;;; # FORKING
 2ADD;R;;; # NONFORKING
 2ADE;R;;; # SHORT LEFT TACK
 2ADF;R;;; # SHORT DOWN TACK
 2AE0;R;;; # SHORT UP TACK
 2AE1;N;;; # PERPENDICULAR WITH S
 2AE2;R;vDdash; # VERTICAL BAR TRIPLE RIGHT TURNSTILE
 2AE3;R;dashV;; # DOUBLE VERTICAL BAR LEFT TURNSTILE
 2AE4;R;Dashv;ISOAMSR; # VERTICAL BAR DOUBLE LEFT TURNSTILE
 2AE5;R;;; # DOUBLE VERTICAL BAR DOUBLE LEFT TURNSTILE
 2AE6;R;Vdashl;ISOAMSR; # LONG DASH FROM LEFT MEMBER OF DOUBLE VERTICAL
 2AE7;R;Barv;ISOAMSR; # SHORT DOWN TACK WITH OVERBAR
 2AE8;R;vBar;ISOAMSR; # SHORT UP TACK WITH UNDERBAR
 2AE9;R;vBarv;ISOAMSR; # SHORT UP TACK ABOVE SHORT DOWN TACK
 2AEA;R;barV;; # DOUBLE DOWN TACK
 2AEB;R;Vbar;ISOAMSR; # DOUBLE UP TACK
 2AEC;R;Not;ISOTECH; # DOUBLE STROKE NOT SIGN
 2AED;R;bNot;ISOTECH; # REVERSED DOUBLE STROKE NOT SIGN
 2AEE;R;rnmid;ISOAMSN; # DOES NOT DIVIDE WITH REVERSED NEGATION SLASH
 2AEF;R;cirimid;ISOAMSA; # VERTICAL LINE WITH CIRCLE ABOVE
 2AF0;R;midcir;ISOAMSA; # VERTICAL LINE WITH CIRCLE BELOW

2AF1;N;topcir;ISOTECH; # DOWN TACK WITH CIRCLE BELOW
 2AF2;R;nghpar;ISOTECH; # PARALLEL WITH HORIZONTAL STROKE
 2AF3;R;parsim;ISOAMSN; # PARALLEL WITH TILDE OPERATOR
 2AF4;B;vert3;; # TRIPLE VERTICAL BAR BINARY RELATION
 2AF5;B;;; # TRIPLE VERTICAL BAR WITH HORIZONTAL STROKE
 2AF6;B;vellipv;; # TRIPLE COLON OPERATOR
 2AF7;R;;; # STACKED VERY MUCH LESS-THAN
 2AF8;R;;; # STACKED VERY MUCH GREATER-THAN
 2AF9;R;;; # DOUBLE-LINE SLANTED LESS-THAN OR EQUAL TO
 2AFA;R;;; # DOUBLE-LINE SLANTED GREATER-THAN OR EQUAL TO
 2AFB;B;;; # TRIPLE SOLIDUS BINARY RELATION
 2AFC;L;;; # LARGE TRIPLE VERTICAL BAR OPERATOR
 2AFD;B;parsl;ISOTECH; # DOUBLE SOLIDUS OPERATOR
 2AFE;B;;; # WHITE VERTICAL BAR
 2AFF;L;;; # N-ARY WHITE VERTICAL BAR
 3008;X;;;(deprecated for math use) # LEFT DOUBLE ANGLE
 BRACKET
 3008;X;;;(deprecated for math use) # LEFT DOUBLE ANGLE
 BRACKET
 3014;O;lbbrrk;ISOTECH;left broken bracket # LEFT TORTOISE
 SHELL BRACKET
 3015;C;rbbrrk;ISOTECH;right broken bracket # RIGHT TORTOISE
 SHELL BRACKET
 3018;O;loang;ISOTECH; # LEFT WHITE TORTOISE SHELL BRACKET
 3019;C;roang;ISOTECH; # RIGHT WHITE TORTOISE SHELL
 BRACKET
 301A;X;;;(deprecated for math use) # LEFT WHITE SQUARE
 BRACKET
 301B;X;;;(deprecated for math use) # RIGHT WHITE SQUARE
 BRACKET
 306E;N;;; # HIRAGANA LETTER NO
 FE00;;; # VARIATION SELECTOR-1
 FE35;;ovrpar;;over parenthesis # PRESENTATION FORM FOR
 VERTICAL LEFT PARENTHESIS
 FE36;;udrpar;;under parenthesis # PRESENTATION FORM FOR
 VERTICAL RIGHT PARENTHESIS
 FE37;;ovrcub;;over brace # PRESENTATION FORM FOR VERTICAL
 LEFT CURLY BRACKET
 FE38;;udrcub;;under brace # PRESENTATION FORM FOR VERTICAL
 RIGHT CURLY BRACKET
 1D400..1D454;A;;; # MATHEMATICAL BOLD CAPITAL A..ITALIC
 SMALL G
 1D456..1D49B;A;;; # MATHEMATICAL ITALIC SMALL I..BOLD
 ITALIC SMALL Z
 1D49C;A;Ascr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL A
 #1D49D=212C;A;Bscr;ISOMSCR; # SCRIPT CAPITAL B <reserved>
 1D49E;A;Cscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL C
 1D49F;A;Dscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL D
 #1D4A0=2130;A;Escr;ISOMSCR; # SCRIPT CAPITAL E <reserved>
 #1D4A1=2131;A;Fscr;ISOMSCR; # SCRIPT CAPITAL F <reserved>
 1D4A2;A;Gscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL G
 #1D4A3=210B;A;Hscr;ISOMSCR; # SCRIPT CAPITAL H <reserved>
 #1D4A4=2110;A;Iscr;ISOMSCR; # SCRIPT CAPITAL I <reserved>
 1D4A5;A;Jscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL J
 1D4A6;A;Kscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL K
 #1D4A7=2112;A;Lscr;ISOMSCR; # SCRIPT CAPITAL L <reserved>
 #1D4A8=2133;A;Mscr;ISOMSCR; # SCRIPT CAPITAL M <reserved>
 >
 1D4A9;A;Nscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL N
 1D4AA;A;Oscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL O
 1D4AB;A;Pscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL P
 1D4AC;A;Qscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL Q
 #1D4AD=211B ;A;Rscr;ISOMSCR; # SCRIPT CAPITAL R <reserved>
 >
 1D4AE;A;Sscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL S
 1D4AF;A;Tscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL T
 1D4B0;A;Uscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL U
 1D4B1;A;Vscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL V
 1D4B2;A;Wscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL W
 1D4B3;A;Xscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL X
 1D4B4;A;Yscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL Y
 1D4B5;A;Zscr;ISOMSCR; # MATHEMATICAL SCRIPT CAPITAL Z
 1D4B6;A;ascr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL A
 1D4B7;A;bscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL B
 1D4B8;A;cscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL C
 1D4B9;A;dscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL D
 #1D4BA=212F;A;escr;ISOMSCR; # SCRIPT SMALL E <reserved>
 1D4BB;A;fscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL F

#1D4BC=210A;A;gscr;ISOMSCR; # SCRIPT SMALL G <reserved>
 1D4BD;A;hscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL H
 1D4BE;A;iscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL I
 1D4BF;A;jscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL J
 1D4C0;A;kscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL K
 1D4C1;A;lscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL L
 1D4C2;A;mscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL M
 1D4C3;A;nscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL N
 #1D4C4=2134;A;oscr;ISOMSCR; # SCRIPT SMALL O <reserved>
 1D4C5;A;pscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL P
 1D4C6;A;qscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL Q
 1D4C7;A;rscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL R
 1D4C8;A;sscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL S
 1D4C9;A;tscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL T
 1D4CA;A;uscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL U
 1D4CB;A;vscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL V
 1D4CC;A;wscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL W
 1D4CD;A;xscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL X
 1D4CE;A;yscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL Y
 1D4CF;A;zscr;ISOMSCR; # MATHEMATICAL SCRIPT SMALL Z
 1D4D0..1D503;A;;; # MATHEMATICAL BOLD SCRIPT CAPITAL A..
 SMALL Z
 1D504;A;Afr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL A
 1D505;A;Bfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL B
 #1D506=212D;A;Cfr;ISOMFRK; # FRAKTUR CAPITAL C <reserved>
 >
 1D507;A;Dfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL D
 1D508;A;Efr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL E
 1D509;A;Ffr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL F
 1D50A;A;Gfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL G
 #1D50B=210C;A;Hfr;ISOMFRK; # FRAKTUR CAPITAL H <reserved>
 >
 #1D50C=2111;A;Ifr;ISOMFRK; # FRAKTUR CAPITAL I <reserved>
 1D50D;A;Jfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL J
 1D50E;A;Kfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL K
 1D50F;A;Lfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL L
 1D510;A;Mfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL M
 1D511;A;Nfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL N
 1D512;A;Ofr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL O
 1D513;A;Pfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL P
 1D514;A;Qfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL Q
 #1D515=211C;A;Rfr;ISOMFRK; # FRAKTUR CAPITAL R <reserved>
 1D516;A;Sfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL S
 1D517;A;Tfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL T
 1D518;A;Ufr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL U
 1D519;A;Vfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL V
 1D51A;A;Wfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL W
 1D51B;A;Xfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL X
 1D51C;A;Yfr;ISOMFRK; # MATHEMATICAL FRAKTUR CAPITAL Y
 #1D51D=2128;A;Zfr;ISOMFRK; # FRAKTUR CAPITAL Z <reserved>
 1D51E;A;af;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL A
 1D51F;A;bfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL B
 1D520;A;cfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL C
 1D521;A;dfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL D
 1D522;A;efr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL E
 1D523;A;ffr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL F
 1D524;A;gfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL G
 1D525;A;hfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL H
 1D526;A;iffr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL I
 1D527;A;jfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL J
 1D528;A;kfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL K
 1D529;A;lfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL L
 1D52A;A;mfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL M
 1D52B;A;nfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL N
 1D52C;A;ofr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL O
 1D52D;A;pf;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL P
 1D52E;A;qfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL Q
 1D52F;A;rfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL R
 1D530;A;sfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL S
 1D531;A;tfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL T
 1D532;A;ufr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL U
 1D533;A;vfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL V
 1D534;A;wfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL W
 1D535;A;xfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL X
 1D536;A;yfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL Y
 1D537;A;zfr;ISOMFRK; # MATHEMATICAL FRAKTUR SMALL Z
 1D538;A;Aopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK
 CAPITAL A

CAPITAL B
 #1D53A=2102;A Copf ISOMOPF # DOUBLE-STRUCK CAPITAL C <reserved>
 1D53B;A;Dopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL D
 1D53C;A;Eopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL E
 1D53D;A;Fopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL F
 1D53E;A;Gopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL G
 #1D53F=210D;A Hopf ISOMOPF # DOUBLE-STRUCK CAPITAL H <reserved>
 1D540;A;Iopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL I
 1D541;A;Jopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL J
 1D542;A;Kopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL K
 1D543;A;Lopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL L
 1D544;A;Mopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL M
 #1D545=2115;A;Nopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL N <reserved>
 1D546;A;Oopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL O
 #1D547=2119;A;Popf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL P <reserved>
 #1D548=211A;A;Qopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL Q <reserved>
 #1D549=211D;A;Ropf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL R <reserved>
 1D54A;A;Sopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL S
 1D54B;A;Topf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL T
 1D54C;A;Uopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL U
 1D54D;A;Vopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL V
 1D54E;A;Wopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL W
 1D54F;A;Xopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL X
 1D550;A;Yopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL Y
 #1D551=2124;A;Zopf;ISOMOPF; # MATHEMATICAL DOUBLE-STRUCK CAPITAL Z <reserved>
 1D552;A;aopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL A
 1D553;A;bopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL B
 1D554;A;copf;; # MATHEMATICAL DOUBLE-STRUCK SMALL C
 1D555;A;dopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL D
 1D556;A;eopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL E
 1D557;A;fopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL F
 1D558;A;gopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL G
 1D559;A;hopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL H
 1D55A;A;iopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL I
 1D55B;A;jopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL J
 1D55C;A;kopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL K
 1D55D;A;lopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL L
 1D55E;A;mopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL M
 1D55F;A;nopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL N
 1D560;A;oopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL O
 1D561;A;popf;; # MATHEMATICAL DOUBLE-STRUCK SMALL P
 1D562;A;qopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL Q
 1D563;A;ropf;; # MATHEMATICAL DOUBLE-STRUCK SMALL R
 1D564;A;sopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL S
 1D565;A;topf;; # MATHEMATICAL DOUBLE-STRUCK SMALL T
 1D566;A;uopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL U
 1D567;A;vopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL V
 1D568;A;wopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL W
 1D569;A;xopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL X
 1D56A;A;yopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL Y
 1D56B;A;zopf;; # MATHEMATICAL DOUBLE-STRUCK SMALL Z
 1D56C..1D6A3;A;;; # MATHEMATICAL BOLD FRAKTUR CAPITAL A..
 MONOSPACE SMALL Z
 1D6A8..1D7C9;A;;; # MATHEMATICAL BOLD CAPITAL ALPHA..SANS

1D6A8..1D7C9;A;;; # MATHEMATICAL BOLD CAPITAL ALPHA..SANS
 -SERIF BOLD ITALIC PI SYMBOL
 1D7CE..1D7FF;N;;; # MATHEMATICAL BOLD DIGIT 0..MONOSPACE
 DIGIT 9