

# Diverse Mathematical Symbols for Arabic, Additional characters proposed to Unicode

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## **Abstract**

Here are some symbols used in Arabic mathematical presentation [3] [4] but are not yet in Unicode Standard [5].

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## **1 Overview**

The **RamzArab** font available, includes some of these characters. It's in OpenType format [6] and converted in METAFONT as a L<sup>A</sup>T<sub>E</sub>X package [7].

The **Antisym** font available, includes some of these characters witch glyphs are drawing by hand, in METAFONT as a L<sup>A</sup>T<sub>E</sub>X package [10].

The **Arrows** font available, includes all these arrows characters. It's in OpenType format [8] and converted in METAFONT as a L<sup>A</sup>T<sub>E</sub>X package [9].

The shapes of the reference glyphs used are not frozen. They are continually being improved in *Multilingual scientific e-document processing* Project at Al-khawarizmi Atelier.

## 2 Radix symbols with Arabic-Indic digits

The radix symbols with Arabic-Indic digits from Table 1 are used in Arabic mathematical presentation. They are not mirrored [2], but are always written right-to-left. While mathematical layout software can use markup to create radix symbols of any order, these two are common enough in general usage that explicit code points should be assigned. Consequently they are proposed for encoding here.

These characters should have general category Sm, neutral right-to-left directionality and should not mirror.

0606	∛	ARABIC-INDIC CUBE ROOT
		→ 221B √
0607	∜	ARABIC-INDIC FOURTH ROOT
		→ 221C √

Table 1: Mathematical symbols with no appropriate mirroring

## 3 Letter-like symbol

A Letter-like symbol (see Table 2) for ray in Arabic is proposed for encoding here.

This character should have general category Sm, strong right-to-left directionality and should not mirror.

0608	س	ARABIC RAY
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Table 2: Letter-like symbol

## 4 General punctuation

Two signs (see Table 3) for per mille and per ten thousand with the Arabic-Indic digit zero are proposed for encoding here.

These characters should have general category Sm, neutral right-to-left directionality and should not mirror.

0609	٪.	ARABIC-INDIC PER MILLE SIGN → 2030 ‰ per mille sign
060A	٪..	ARABIC-INDIC PER TEN THOUSAND SIGN → 2031 ‰ per ten thousand sign

Table 3: General punctuation

## 5 Stars, asterisks and snowflakes

An outline white star (see Figure 1 and Table 4) is proposed for encoding here.

This character should have general category So and have neutral directionality.

269D	☆	OUTLINED WHITE STAR • Morocco sign
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Table 4: Star

## 6 Mathematical arrows

The majority of symbols used in Latin mathematical presentation are the mirrored corresponding used in Arabic presentation. In the Unicode Standard, there is the mirrored propriety for some characters [2]. However, arrows don't have this property. Some arrows listed in Unicode and used in mathematics [2] don't include symmetrical signs. In particular, signs for all symbols from Table 5 are proposed with the specification LEFTWARDS, in contrast to RIGHTWARDS, or the reverse.

The arrows listed in Table 5 are the mirrored of the ones with code: 21F4,21F6, 27F4, 27FF, 2900, 2901, 2905, 2910, 2911, 2914, 2915, 2916, 2917, 2918, 2933, 2947, 2971, 2972 , 2975, 2977, and 297A respectively.

2B14		LEFT ARROW WITH SMALL CIRCLE
2B15		TREE LEFTWARDS ARROWS
2B16		LEFT ARROW WITH CIRCLED PLUS
2B17		LONG LEFTWARDS SQUIGGLE ARROW → 21DC  leftwards squiggle arrow
2B18		LEFTWARDS TWO-HEADED ARROW WITH VERTICAL STROKE
2B19		LEFTWARDS TWO-HEADED ARROW WITH DOUBLE VERTICAL STROKE
2B1A		LEFTWARDS TWO-HEADED ARROW FROM BAR
2B1B		LEFTWARDS TWO-HEADED TRIPLE DASH ARROW
2B1C		LEFTWARDS ARROW WITH DOTTED STEM
2B1D		LEFTWARDS ARROW WITH TAIL WITH VERTICAL STROKE
2B1E		LEFTWARDS ARROW WITH TAIL WITH DOUBLE VERTICAL STROKE
2B1F		LEFTWARDS TWO-HEADED ARROW WITH TAIL
2B21		LEFTWARDS TWO-HEADED ARROW WITH TAIL WITH VERTICAL STROKE
2B22		LEFTWARDS TWO-HEADED ARROW WITH TAIL WITH DOUBLE VERTICAL STROKE
2B23		LEFTWARDS ARROW THROUGH X
2B24		WAVE ARROW POINTING DIRECTLY LEFT → 219C  leftwards wave arrow
2B25		EQUALS SIGN ABOVE LEFTWARDS ARROW
2B26		TILDE OPERATOR ABOVE LEFTWARDS ARROW
2B27		LEFTWARDS ARROW ABOVE ALMOST EQUAL TO
2B28		RIGHTWARDS ARROW THROUGH LESS-THAN
2B29		RIGHTWARDS ARROW THROUGH SUBSET

Table 5: Mathematical arrows

## References

- [1] Unicode Technical Report #25, *Unicode Support for Mathematics*,  
<http://www.unicode.org/reports/tr25/>.
- [2] Unicode, *Bidi Mirroring Glyph Property*,  
<http://www.unicode.org/Public/UNIDATA/BidiMirroring.txt>.
- [3] W3C Math Interest Group Note, *Arabic Mathematical Notation*,  
<http://www.w3.org/TR/arabic-math/>.
- [4] Mohamed Jamal Eddine Benatia, Azzeddine Lazrek and Khalid Sami,  
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Unicode Conference (IUC), IUC 27, Berlin, Germany, April 6-8, 2005,  
<http://www.ucam.ac.ma/fssm/rydarab/doc/communic/unicodem.pdf>.
- [5] Azzeddine Lazrek, *Arabic mathematical symbols for Unicode*,  
<http://www.ucam.ac.ma/fssm/rydarab/english/unicode.htm>.
- [6] Arabic mathematical symbols font RamzArab in OpenType,  
<http://www.ucam.ac.ma/fssm/rydarab/doc/unicode/ramzarab.ttf>.
- [7] Arabic mathematical symbols font RamzArab as package for L<sup>A</sup>T<sub>E</sub>X,  
<http://www.ucam.ac.ma/fssm/rydarab/system/zip/ramzarab.zip>.
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<http://www.ucam.ac.ma/fssm/rydarab/doc/unicode/arrows.ttf>.
- [9] Arrows symbols font Arrows as package for L<sup>A</sup>T<sub>E</sub>X,  
<http://www.ucam.ac.ma/fssm/rydarab/system/zip/arrows.zip>.
- [10] Antic symbols font AntiSym as package for L<sup>A</sup>T<sub>E</sub>X,  
<http://www.ucam.ac.ma/fssm/rydarab/system/zip/antisym.zip>.

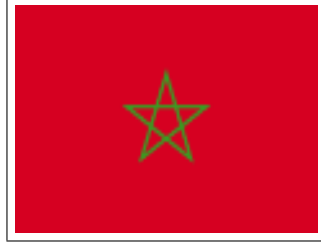


Figure 1: Morocco sign

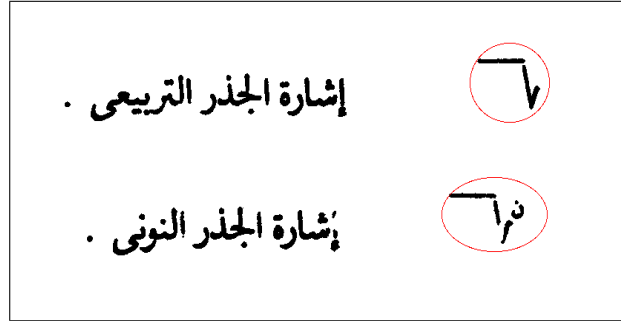


Figure 2: Root symbol in Amman Convention [1.1]

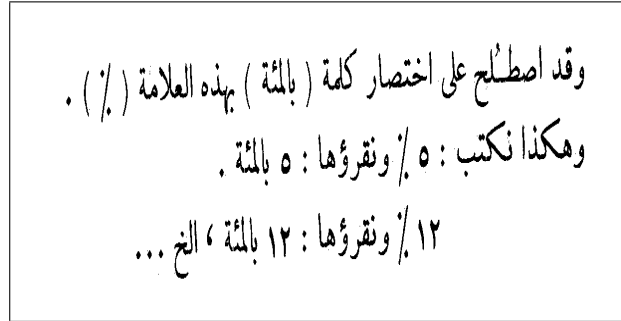


Figure 3: Percent symbol in Handbook [3.6]

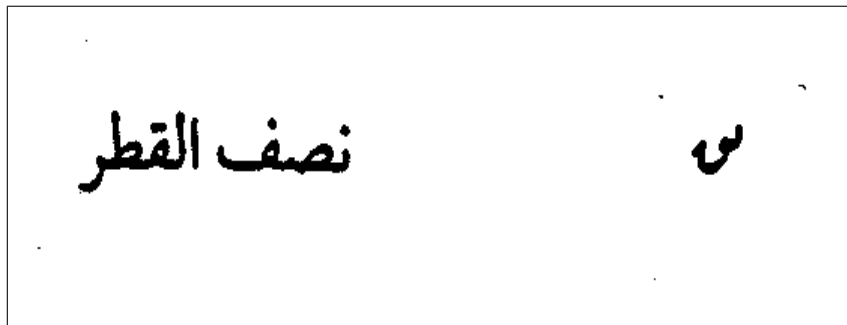


Figure 4: Ray symbol in Amman convention [1.1]