Arabic Mathematical Alphabetic Symbols,
Additional characters proposed to Unicode

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July 10, 2005

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1 Overview

The Unicode Standard provides a quite complete set of conventional mathematical alphabetic symbols to support publication of mathematics in a Latin script based writing. Standard Arabic letters as well as some ligatures and

composed characters, used for general text, are already present in the Unicode Standard. Arabic alphabet based scripts make use of local ways for writing mathematics. Even tough some local symbols can be obtained via mirroring of already existing symbols, there are many symbols found in Arabic mathematical handbooks that are not yet part of the Unicode Standard and can't be obtained readily through a simple mirroring.

In Arabic presentation, *Arabic mathematical expressions* use *special symbols* and flow *from right to left*. Most of these symbols had been adopted through official international conventions such as *The Amman's 1987 convention* [12]. *The Amman's convention* abstract the conference under the topic *Scientific symbols and method of their use in Arabic language* gathering the *Union of the Arab scientific linguistic groupings* at Amman, Jordan in 1987.

Arabic mathematical alphabetic symbols constitute a widely used version of the Arabic alphabet, used over many centuries and in many contexts (e.g. epigraphical, manuscript and manual books, traditional printed editions). This way of writing expressions corresponds to the standards and conventions adopted in languages using Arabic alphabet based scripts, such as Arabic or Persian. The majority of the handbooks of mathematics in use in Middle East, Libya, Algeria, ... are typeset according to this way of putting mathematics into type. Before the adoption of the French mathematical notation, Moroccan handbooks used to respect this way of typesetting symbols. Up till now, the symbols are written by hand or, at best, with a typewriter. They are printed then directly with the tools of traditional printing works without assistance of the computer. Generally, the use of computers never goes beyond processing the literal part of the document.

Some examples in [9] show both modern printed editions (with the **Ry-DArab** system [3]) and old ones in the same page.

In some cases, both types of presentations of mathematics, Arabic and Latin, may be required in the same text.

Therefore, the addition of those characters is necessary for the correct and accurate representation of ancient and medieval Arabic mathematical expressions [5] and [11]. It is also necessary in order to complement the Arabic alphabet based scripts which already exists in the Unicode Standard.

This proposal is restricted to *Arabic mathematical alphabetic symbols*, presented by the character code tables and list of character names, to be added into the Unicode Standard [7] and [4]. Some other proposals can be found in [9].

The **RamzArab** font available, includes all these characters. It's in OpenType format, for publication of the standard [8] and [10]. The shapes of the reference glyphs used are not frozen. They are continually being im-

proved in *Multilingual scientific e-document processing* Team/Project.

Several samples presented are very poor visual quality. They are scanned from old handbooks. Some boxes are add to some symbols in Figures in order to emphases them and understand the purpose of the samples.

2 Basic mathematical alphabetic symbols

In mathematics, style variations are very important semantically [2]. One reason for using mathematical alphabetic symbols in Latin based script texts, is that they are typeset in a different way from that in ordinary text. For example, the character spacing is different in mathematic mode than in text mode (e.g., let n a number in the set N part of the natural number set $\mathbb{N}$ in the context $\mathcal{N}$). For right-to-left Arabic math text, the usual shaping (ligaturing) of Arabic letters is omitted in mathematical mode except for abbreviations or units entities like trigonometric function names.

The basic mathematical alphabetic letter-like symbols used in Arabic mathematical handbooks are of six forms: *isolated*, *initial*, *tailed*, *stretched*, *looped*, and *double-struck* (see Table 1). It should be noted that the tailed form is not contained in the Amman's convention (see Figure 2) but is commonly present in the handbooks.

ج	ح	MATHEMATICAL JEEM ISOLATED FORM
		≈ <font> <isolated> 062C ج Arabic letter jeem
جـ	حـ	MATHEMATICAL JEEM INITIAL FORM
		≈ <font> <initial> 062C ج Arabic letter jeem
		≈ <font> FE9F جـ Arabic letter jeem initial form
جـ	حـ	MATHEMATICAL JEEM TAILED FORM
		≈ <font> FE9F جـ 06C1 ه
جـ	حـ	MATHEMATICAL JEEM STRETCHED FORM
		≈ <font> FE9F جـ FE8E ل
ج	ح	MATHEMATICAL JEEM LOOPED FORM
		≈ <font> <isolated> 062C ج Arabic letter jeem
ج	ح	MATHEMATICAL JEEM DOUBLE-STRUCK FORM
		≈ <font> <isolated> 062C ج Arabic letter jeem

Table 1: Example of mathematical alphabetic symbols

There are two alphabetic orders in Arabic. The one used in mathematics

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Letter		Pronunciation
ب	د	BEH, it comes before the letter TEH and THEH
ح	ح	JEEM, it comes before HAH and KHAH
ر		REH, though it comes after the letter ZAIN
ڢ	ڡ	FEH, instead of QAF
ٯ		QAF

Table 2: Dot-less letter-like symbols ambiguous names

or alphabetic numeration list is the *a, b, j, d, . . .* (namely ا, ب, ج, د, . . .) order (see Figure 2). It differs from the *a, b, t, th, . . .* (namely ا, ب, ت, ث, . . .) order usually adopted in modern dictionaries.

In order to avoid ambiguities, the Arabic character types used in mathematics are generally based on dot-less letters (see Figure 18). As some Arabic letters differ only by the addition of dots below or above basic symbols, the basic *dot-less* symbols list is smaller than the complete list of the alphabet. Moreover, care should be taking in naming the ambiguous dot-less letter-like symbols (see Table 2).

On the other hand, in order to provide a big amount of symbols in use, to satisfy both local area using dot-less characters and those using characters with dots, mathematical alphabetic symbols are to be proposed with and without dots. The proposition remains so in the philosophy of the Unicode Standard that recommends representing the symbol not the glyph. Actually, in the following table (see Table 3), the symbols are presented with and without dots in the *a-b-j-d* order.

The glyphs of the letters ALEF[1], HEH and KAF (namely ا, ه and ك respectively), in isolated and double-struck forms, can generate some confusions. They don't appear in these forms in dot-less styles.

The glyphs of the letters ALEF, DAL, WAW, ZAIN, TAH, REH, THAL and ZAH (namely ا, د, و, ز, ط, ر, ذ and ظ respectively), in isolated form, are the same as in initial form. So, these symbols will appear in the isolated form set only.

The glyphs of the letters ALEF, DAL, WAW, ZAIN, REH and THAL (namely ا, د, و, ز, ر and ذ respectively), in the tailed and stretched forms, are composed with two elements. They won't appear in these forms in dot-less styles.

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[1]All along this paper, Arabic characters are named according to the Unicode Standard way, in spite of the non conformity for some letters. In fact, the letter ز generally pronounced ZAY instead of ZAIN.

ISOLATED		INITIAL		TAIL		STRETCHED		LOOPED		DOUBLE-STRUCK	
DOT	DOT-LESS	DOT	DOT-LESS	DOT	DOT-LESS	DOT	DOT-LESS	DOT	DOT-LESS	DOT	DOT-LESS

Table 3: Mathematical alphabetic symbols

3 Particular mathematical alphabetic symbols

Some glyphs used in Arabic mathematical presentation are not really Arabic letters but particular forms of mathematical alphabetic symbols used in

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Arabic mathematical handbooks (see Figure 2,3 and Table 4,5).

The glyph of the letter ALEF ‏ا‎ can be confused with the Arabic-Indic digit ONE ‏١‎. Thus, it's replaced by ‏أ‎. The glyph of the letter HEH ‏ه‎ can be confused with the Arabic-Indic digit FIVE ‏٥‎ in the isolated and double-struck forms. Thus, it's replaced by ‏ھ‎. The glyph of the letter KAF ‏ك‎ is composed with two elements in the isolated and double-struck forms. Thus, it's replaced by either ‏ک‎ or ‏ڪ‎. The glyph of the letter NOON can be found in different orientation and styles, with and without dot, (‏ن‎ ‏ں‎, ‏ں‎ ‏ں‎, ‏ں‎ ‏ں‎, ‏ں‎ ‏ں‎, ‏د‎ ‏د‎) according to the local area (see Figure 14 and Figure 15).

‏أ‎	MATHEMATICAL ALEF
	≈ `<font>` `<isolated>` `0627` ‏ا‎ Arabic letter alef
‏د‎	MATHEMATICAL DAL
	≈ `<font>` `<isolated>` `062F` ‏د‎ Arabic letter dal
‏ھ‎	MATHEMATICAL HEH
‏ے‎	MATHEMATICAL YEH ~~BARREE~~ [1]
	≈ `<font>` `<isolated>` `06D2` ‏ے‎ Arabic letter yeh barree
‏ک‎	MATHEMATICAL KAF
‏ڪ‎	MATHEMATICAL SWASH KAF
	≈ `<font>` `<isolated>` `06AA` ‏ڪ‎ Arabic letter swash kaf
‏لا‎	MATHEMATICAL LAMALEF
	≈ `<font>` `<isolated>` `FEFB` ‏لا‎ Arabic ligature lam with alef
‏م‎	MATHEMATICAL MEEM
	≈ `<font>` `<isolated>` `0645` ‏م‎ Arabic letter meem
‏ں‎ ‏ں‎	MATHEMATICAL ~~INVERTED~~ [1]NOON
	≈ `<font>` `<isolated>` `0646` ‏ن‎ Arabic letter noon
‏ر‎	MATHEMATICAL REH
	≈ `<font>` `<isolated>` `0631` ‏ر‎ Arabic letter reh
‏ز‎	MATHEMATICAL ZAIN
	≈ `<font>` `<isolated>` `0632` ‏ز‎ Arabic letter zain
‏ء‎	MATHEMATICAL HAMZA
	≈ `<font>` `<isolated>` `0621` ‏ء‎ Arabic letter hamza

Table 4: Particular forms of mathematical alphabetic symbols
[1]Really, we propose to not make this attribute.

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آ	MATHEMATICAL DOUBLE-STRUCK ALEF
	≈ <font> <isolated> 0627 ا Arabic letter alef
ذ	MATHEMATICAL DOUBLE-STRUCK DAL
	≈ <font> <isolated> 062F د Arabic letter dal
ه	MATHEMATICAL DOUBLE-STRUCK HEH
ے	MATHEMATICAL DOUBLE-STRUCK YEH ~~BARREE~~ [1]
	≈ <font> <isolated> 06D2 ے Arabic letter yeh barree
ک	MATHEMATICAL DOUBLE-STRUCK KAF
ڪ	MATHEMATICAL DOUBLE-STRUCK SWASH KAF
	≈ <font> <isolated> 06AA ڪ Arabic letter swash kaf
لا	MATHEMATICAL DOUBLE-STRUCK LAMALEF
	≈ <font> <isolated> FEFB لا Arabic ligature lam with alef
م	MATHEMATICAL DOUBLE-STRUCK MEEM
	≈ <font> <isolated> 0645 م Arabic letter meem
ں ں	MATHEMATICAL DOUBLE-STRUCK ~~INVERTED~~ [1]NOON
	≈ <font> <isolated> 0646 ن Arabic letter noon
ر	MATHEMATICAL DOUBLE-STRUCK REH
	≈ <font> <isolated> 0631 ر Arabic letter reh
ز	MATHEMATICAL DOUBLE-STRUCK ZAIN
	≈ <font> <isolated> 0632 ز Arabic letter reh
ء	MATHEMATICAL DOUBLE-STRUCK HAMZA
	≈ <font> <isolated> 0621 ء Arabic letter hamza

Table 5: Double-struck particular forms of mathematical alphabetic symbols
[1]Really, we propose to not make this attribute.

4 Exceptional mathematical alphabetic symbols

Some glyphs used in Arabic mathematical presentation are not really Arabic letters but symbols used in physics or in Arabic alphabetical based like scripts as Persian (see Figure 4 and Table 6).

ب	MATHEMATICAL PEH ISOLATED FORM
	≈ \<font> \<isolated> 067E ب Arabic letter peh
ب	MATHEMATICAL PEH LOOPED FORM
	≈ \<font> \<isolated> 067E ب Arabic letter peh
ج	MATHEMATICAL TCHEH ISOLATED FORM
	≈ \<font> \<isolated> 0686 ج Arabic letter tcheh
ج	MATHEMATICAL TCHEH LOOPED FORM
	≈ \<font> \<isolated> 0686 ج Arabic letter tcheh
ڤ	MATHEMATICAL VEH ISOLATED FORM
	≈ \<font> \<isolated> 06A4 ڤ Arabic letter veh
ڤ	MATHEMATICAL VEH LOOPED FORM
	≈ \<font> \<isolated> 06A4 ڤ Arabic letter veh
ڠ	MATHEMATICAL AIN WITH TREE DOTS ABOVE ISOLATED FORM
	≈ \<font> \<isolated> 06A0 ڠ Arabic letter ain with tree dots above
ڠ	MATHEMATICAL AIN WITH TREE DOTS ABOVE LOOPED FORM
	≈ \<font> \<isolated> 06A0 ڠ Arabic letter ain with tree dots above

Table 6: Exceptional forms of mathematical alphabetic symbols

5 Special mathematical alphabetic symbols

5.1 Large symbols

The Arabic n-ary summation operator is denoted by either ⲅ and مج sym-
bols according to the local area (see Figure 7 and Table 7).

The character ARABIC N-ARY SUMMATION ⲅ, mirrored image of
N-ARY SUMMATION Σ will be presented in another proposal to Unicode.

The Arabic n-ary product operator is denoted by either Π and جد sym-
bols according to the local area (see Figure 8 and Table 7).

The Arabic limit operator is denoted by نہا symbol (see Table 7).

The Arabic factorial operator is denoted by either ! and ل symbols ac-
cording to the local area (see Figure 9 and Table 7).

The symbols Summation, Product and Limit can be denoted with dots
(نہا, جد and مج) or without dots (مح, حد and ہا).

We propose to add the *large*, or less supported *alphabetic*, or the least
supported *conventional*, adjective attribute in there names for those symbols.

Obviously, some software tools, such as TeX or MathML, can be help to

مجـ	محـ	ARABIC LARGE N-ARY SUMMATION
		≈ <font> FCCE مجـ Arabic ligature meem with jeem initial form
حـد	جـد	ARABIC LARGE N-ARY PRODUCT
		≈ <font> FCCE جـد Arabic ligature jeem with thal
نهـا	هـا	ARABIC LARGE LIMIT
لـ		ARABIC LARGE FACTORIAL

Table 7: Mathematical large symbols

combine any text string with any symbols as needed. WG 2 has resolved
in Resolution M38.12 not to add any more Arabic presentation forms to the
standard and suggests users to employ appropriate input methods, rendering
and font technologies to meet the user requirements. We propose those *large
operators* for addition to the Unicode Standard even though they don't have
similar entities in Latin. The shape of those ligatures is unusual compared
to the layout in regular text. Moreover, the size of these ligatures symbols
varies according to the covered expressions (see Figure 1).
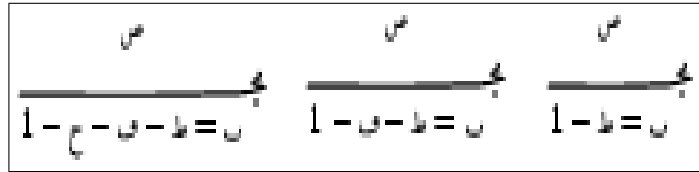
Figure 1: Variable-sized conventional summation operator

The n-ary operators like summation and integration may expand in size
to fit with their associated expressions. The stretching can be performed by
some software such as CurExt [6] [11]. These operators generally also take
limits. As in the Latin alphabet based notation, the place of the limits in
an operator is not the same in-line with text as in displayed expression alone
in-line.

5.2   Combined symbols

The "equal by definition" $\stackrel{\text{def}}{=}$ operator symbol is already existing (see Ta-
ble 8). We propose "equivalent by definition" $\stackrel{\text{def}}{\Longleftrightarrow}$ operator symbol and also
"combining definition" $\stackrel{\text{def}}{\bigcirc}$ in order to be able to use it with another character
(see Table 9).

The two characters COMBINING DEFINITION $\overset{\text{def}}{\bigcirc}$ and EQUIVALENT TO BY DEFINITION $\overset{\text{def}}{\Longleftrightarrow}$ will be presented in another proposal to Unicode [9].

$$\overset{\text{def}}{=} \quad \text{EQUAL TO BY DEFINITION}$$

Table 8: Existing by definition symbol

$\overset{\text{def}}{\bigcirc}$	COMBINING DEFINITION
$\overset{\text{def}}{\Longleftrightarrow}$	EQUIVALENT TO BY DEFINITION

Table 9: Proposal by definition symbols

The Arabic operators "equal to by definition" and "equivalent to by definition" may be proposed as either compact symbols and element that can be combined with other symbols (see Figure 6 and Table 10).

$\overset{تعر}{\bigcirc}$ $\overset{نعر}{\bigcirc}$	COMBINING ARABIC DEFINITION	
	→ xxxx $\overset{\text{def}}{\bigcirc}$	
$\overset{تعر}{=}$ $\overset{نعر}{=}$	ARABIC EQUAL TO BY DEFINITION	
	→ 225D $\overset{\text{def}}{=}$	
$\overset{تعر}{\Longleftrightarrow}$ $\overset{نعر}{\Longleftrightarrow}$	ARABIC EQUIVALENT TO BY DEFINITION	
	→ xxxx $\overset{\text{def}}{\Longleftrightarrow}$	

Table 10: Arabic by definition symbols

5.3   Units

The Arabic square unit, corresponding to the Latin square Km is marked with a special abbreviation كم . It represents an example of various signs for units that are worth of being included in the Unicode Standard (see Table 11).

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كمⵊ ARABIC SQUARE KM

$\approx$ <square>0643 كـ 0645 مٚ

$\rightarrow$ 339E square km

Table 11: Example of unit symbols

5.4 Dates

Two main calendars are in use in the Islamic cultural area: the Hejry (Islamic calendar) and the MylAdy (Gregorian calendar). As the famous marks `AC.` and `BC.` used to distinguish years after and before the year zero. The marks هـ and مٚ are used to make a distinction between the two calendars. Of course, these signs may be added (see Table 12) as special characters.

هـ ARABIC HEJRY DATE
$\approx$ <font> <isolated> 0647 ه Arabic letter heh

مٚ ARABIC MYLADY DATE
$\approx$ <font> <isolated> 0645 مٚ Arabic letter meem

Table 12: Dates marks

6 Character names

The list of character names of *Arabic mathematical alphabetic symbols*, proposed to be added into the Unicode Standard is presented below:

- Isolated form of Arabic mathematical alphabetic symbols (see Table 13);

- Initial form of Arabic mathematical alphabetic symbols (see Table 14);

- Tailed form of Arabic mathematical alphabetic symbols (see Table 15);

- Stretched form of Arabic mathematical alphabetic symbols (see Table 16);

- Looped form of Arabic mathematical alphabetic symbols (see Table 17);

- Double-struck form of Arabic mathematical alphabetic symbols (see Table 18).

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[12] Union of the Arab scientific linguistic groupings, *Scientific symbols and method of their use in Arabic language*, Amman, Jordan, in Arabic, 1987.

|		
ا		MATHEMATICAL ALEF ISOLATED FORM
		≈ \<font\> \<isolated\> 0627 ا Arabic letter alef
ب	ب	MATHEMATICAL BEH ISOLATED FORM
		≈ \<font\> \<isolated\> 0628 ب Arabic letter beh
ج	ح	MATHEMATICAL JEEM ISOLATED FORM
		≈ \<font\> \<isolated\> 062C ج Arabic letter jeem
د	د	MATHEMATICAL DAL ISOLATED FORM
		≈ \<font\> \<isolated\> 062F د Arabic letter dal
ه		MATHEMATICAL HEH ISOLATED FORM
		≈ \<font\> \<isolated\> 0647 ه Arabic letter heh
و	و	MATHEMATICAL WAW ISOLATED FORM
		≈ \<font\> \<isolated\> 0648 و Arabic letter waw
ز	ر	MATHEMATICAL ZAIN ISOLATED FORM
		≈ \<font\> \<isolated\> 0632 ز Arabic letter zain
ح		MATHEMATICAL HAH ISOLATED FORM
		≈ \<font\> \<isolated\> 062D ح Arabic letter hah
ط	ط	MATHEMATICAL TAH ISOLATED FORM
		≈ \<font\> \<isolated\> 0637 ط Arabic letter tah
ى	ى	MATHEMATICAL YEH ISOLATED FORM
		≈ \<font\> \<isolated\> 064A ي Arabic letter yeh
ك		MATHEMATICAL KAF ISOLATED FORM
		≈ \<font\> \<isolated\> 0643 ك Arabic letter kaf
ل	ل	MATHEMATICAL LAM ISOLATED FORM
		≈ \<font\> \<isolated\> 0644 ل Arabic letter lam
م	م	MATHEMATICAL MEEM ISOLATED FORM
		≈ \<font\> \<isolated\> 0645 م Arabic letter meem
ن	ں	MATHEMATICAL NOON ISOLATED FORM
		≈ \<font\> \<isolated\> 0646 ن Arabic letter noon
س	س	MATHEMATICAL SEEN ISOLATED FORM
		≈ \<font\> \<isolated\> 0634 س Arabic letter seen
ع	ع	MATHEMATICAL AIN ISOLATED FORM
		≈ \<font\> \<isolated\> 0639 ع Arabic letter ain
ڡ	ف	MATHEMATICAL FEH ISOLATED FORM
		≈ \<font\> \<isolated\> 0641 ف Arabic letter feh
ص	ص	MATHEMATICAL SAD ISOLATED FORM
		≈ \<font\> \<isolated\> 0635 ص Arabic letter sad
ٯ	ٯ	MATHEMATICAL QAF ISOLATED FORM
		≈ \<font\> \<isolated\> 0642 ق Arabic letter qaf
ر		MATHEMATICAL REH ISOLATED FORM
		≈ \<font\> \<isolated\> 0631 ر Arabic letter reh
ش		MATHEMATICAL SHEEN ISOLATED FORM
		≈ \<font\> \<isolated\> 0634 ش Arabic letter sheen
ت		MATHEMATICAL TEH ISOLATED FORM
		≈ \<font\> \<isolated\> 062A ت Arabic letter teh
ث		MATHEMATICAL THEH ISOLATED FORM
		≈ \<font\> \<isolated\> 062B ث Arabic letter theh
خ		MATHEMATICAL KHAH ISOLATED FORM
		≈ \<font\> \<isolated\> 062E خ Arabic letter khah
ذ		MATHEMATICAL THAL ISOLATED FORM
		≈ \<font\> \<isolated\> 0630 ذ Arabic letter thal
ض		MATHEMATICAL DAD ISOLATED FORM
		≈ \<font\> \<isolated\> 0636 ض Arabic letter dad
ظ		MATHEMATICAL ZAH ISOLATED FORM
		≈ \<font\> \<isolated\> 0638 ظ Arabic letter zah
غ		MATHEMATICAL GHAIN ISOLATED FORM
		≈ \<font\> \<isolated\> 063A غ Arabic letter ghain

Table 13: Isolated form of alphabetic symbols

ب	ـب	MATHEMATICAL BEH ISOLATED FORM

≈ <font> <initial> 0628 ب Arabic letter beh

≈ <font> FE91 ـب Arabic letter beh initial form

جـ	حـ	MATHEMATICAL JEEM INITIAL FORM

≈ <font> <initial> 062C ج Arabic letter jeem

≈ <font> FE9F جـ Arabic letter jeem initial form

هـ	هـ	MATHEMATICAL HEH INITIAL FORM

≈ <font> <initial> 0647 ه Arabic letter heh

≈ <font> FEEB هـ Arabic letter heh initial form

MATHEMATICAL HAH INITIAL FORM

≈ <font> <initial> 062D ح Arabic letter hah

≈ <font> FEA3 حـ Arabic letter hah initial form

MATHEMATICAL YEH INITIAL FORM

≈ <font> <initial> 064A ي Arabic letter yeh

≈ <font> FEF3 يـ Arabic letter yeh initial form

MATHEMATICAL KAF INITIAL FORM

≈ <font> <initial> 0643 ك Arabic letter kaf

≈ <font> FEDB كـ Arabic letter kaf initial form

MATHEMATICAL LAM INITIAL FORM

≈ <font> <initial> 0644 ل Arabic letter lam

≈ <font> FEDF لـ Arabic letter lam initial form

MATHEMATICAL MEEM INITIAL FORM

≈ <font> <initial> 0645 م Arabic letter meem

≈ <font> FEE3 مـ Arabic letter meem initial form

MATHEMATICAL NOON INITIAL FORM

≈ <font> <initial> 0646 ن Arabic letter noon

≈ <font> FEE7 نـ Arabic letter noon initial form

MATHEMATICAL SEEN INITIAL FORM

≈ <font> <initial> 0634 س Arabic letter seen

≈ <font> FEB3 سـ Arabic letter seen initial form

MATHEMATICAL AIN INITIAL FORM

≈ <font> <initial> 0639 ع Arabic letter ain

≈ <font> FECB عـ Arabic letter ain initial form

MATHEMATICAL FEH INITIAL FORM

≈ <font> <initial> 0641 ف Arabic letter feh

≈ <font> FED3 فـ Arabic letter feh initial form

MATHEMATICAL SAD INITIAL FORM

≈ <font> <initial> 0635 ص Arabic letter sad

≈ <font> FEBB صـ Arabic letter sad initial form

MATHEMATICAL QAF INITIAL FORM

≈ <font> <initial> 0642 ق Arabic letter qaf

≈ <font> FED7 قـ Arabic letter qaf initial form

MATHEMATICAL SHEEN INITIAL FORM

≈ <font> <initial> 0634 ش Arabic letter sheen

≈ <font> FEB7 شـ Arabic letter sheen initial form

MATHEMATICAL TEH INITIAL FORM

≈ <font> <initial> 062A ت Arabic letter teh

≈ <font> FE97 تـ Arabic letter teh initial form

MATHEMATICAL THEH INITIAL FORM

≈ <font> <initial> 062B ث Arabic letter theh

≈ <font> FE9B ثـ Arabic letter theh initial form

MATHEMATICAL KHAH INITIAL FORM

≈ <font> <initial> 062E خ Arabic letter khah

≈ <font> FEA7 خـ Arabic letter khah initial form

MATHEMATICAL DAD INITIAL FORM

≈ <font> <initial> 0636 ض Arabic letter dad

≈ <font> FEBF ضـ Arabic letter dad initial form

MATHEMATICAL GHAIN INITIAL FORM

≈ <font> <initial> 063A غ Arabic letter ghain

≈ <font> FECF غـ Arabic letter ghain initial form

Table 14: Initial form of alphabetic symbols

بـ ﺑ	ﭑ	MATHEMATICAL BEH TAILED FORM ≈ \<font\> 0628 ب 06C1 ﭑ
جـ جـ	حـ	MATHEMATICAL JEEM TAILED FORM ≈ \<font\> 062C ج 06C1 ﭑ
هـ هـ	هـ	MATHEMATICAL HEH TAILED FORM ≈ \<font\> 0647 ه 06C1 ﭑ
حـ	حـ	MATHEMATICAL HAH TAILED FORM ≈ \<font\> 062D ح 06C1 ﭑ
طـ طـ	طـ	MATHEMATICAL TAH TAILED FORM ≈ \<font\> 0637 ط 06C1 ﭑ
يـ	يـ	MATHEMATICAL YEH TAILED FORM ≈ \<font\> 064A ي 06C1 ﭑ
كـ كـ	كـ	MATHEMATICAL KAF TAILED FORM ≈ \<font\> 0643 ك 06C1 ﭑ
لـ لـ	لـ	MATHEMATICAL LAM TAILED FORM ≈ \<font\> 0644 ل 06C1 ﭑ
مـ مـ	مـ	MATHEMATICAL MEEM TAILED FORM ≈ \<font\> 0645 م 06C1 ﭑ
نـ	نـ	MATHEMATICAL NOON TAILED FORM ≈ \<font\> 0646 ن 06C1 ﭑ
سـ سـ	سـ	MATHEMATICAL SEEN TAILED FORM ≈ \<font\> 0634 س 06C1 ﭑ
عـ عـ	عـ	MATHEMATICAL AIN TAILED FORM ≈ \<font\> 0639 ع 06C1 ﭑ
فـ فـ	فـ	MATHEMATICAL FEH TAILED FORM ≈ \<font\> 0641 ف 06C1 ﭑ
صـ صـ	صـ	MATHEMATICAL SAD TAILED FORM ≈ \<font\> 0635 ص 06C1 ﭑ
قـ		MATHEMATICAL QAF TAILED FORM ≈ \<font\> 0642 ق 06C1 ﭑ
شـ		MATHEMATICAL SHEEN TAILED FORM ≈ \<font\> 0634 ش 06C1 ﭑ
تـ		MATHEMATICAL TEH TAILED FORM ≈ \<font\> 062A ت 06C1 ﭑ
ثـ		MATHEMATICAL THEH TAILED FORM ≈ \<font\> 062B ث 06C1 ﭑ
خـ		MATHEMATICAL KHAH TAILED FORM ≈ \<font\> 062E خ 06C1 ﭑ
ضـ		MATHEMATICAL DAD TAILED FORM ≈ \<font\> 0636 ض 06C1 ﭑ
ظـ		MATHEMATICAL ZAH TAILED FORM ≈ \<font\> 0638 ظ 06C1 ﭑ
غـ		MATHEMATICAL GHAIN TAILED FORM ≈ \<font\> 063A غ 06C1 ﭑ

Table 15: Tailed form of alphabetic symbols

با	١ا		MATHEMATICAL BEH STRETCHED FORM ≈ <font> 0627 ا 0628 ب
جا	حا		MATHEMATICAL JEEM STRETCHED FORM ≈ <font> 0627 ا 062C ج
ها	ها		MATHEMATICAL HEH STRETCHED FORM ≈ <font> 0627 ا 0647 ه
حا			MATHEMATICAL HAH STRETCHED FORM ≈ <font> 0627 ا 062D ح
طا	طا		MATHEMATICAL TAH STRETCHED FORM ≈ <font> 0627 ا 0637 ط
يا			MATHEMATICAL YEH STRETCHED FORM ≈ <font> 0627 ا 064A ي
كا	كا		MATHEMATICAL KAF STRETCHED FORM ≈ <font> 0627 ا 0643 ك
ما	ما		MATHEMATICAL MEEM STRETCHED FORM ≈ <font> 0627 ا 0645 م
نا			MATHEMATICAL NOON STRETCHED FORM ≈ <font> 0627 ا 0646 ن
سا	سا		MATHEMATICAL SEEN STRETCHED FORM ≈ <font> 0627 ا 0634 س
عا	عا		MATHEMATICAL AIN STRETCHED FORM ≈ <font> 0627 ا 0639 ع
فا	فا		MATHEMATICAL FEH STRETCHED FORM ≈ <font> 0627 ا 0641 ف
صا	صا		MATHEMATICAL SAD STRETCHED FORM ≈ <font> 0627 ا 0635 ص
قا			MATHEMATICAL QAF STRETCHED FORM ≈ <font> 0627 ا 0642 ق
شا			MATHEMATICAL SHEEN STRETCHED FORM ≈ <font> 0627 ا 0634 ش
تا			MATHEMATICAL TEH STRETCHED FORM ≈ <font> 0627 ا 062A ت
ثا			MATHEMATICAL THEH STRETCHED FORM ≈ <font> 0627 ا 062B ث
خا			MATHEMATICAL KHAH STRETCHED FORM ≈ <font> 0627 ا 062E خ
ضا			MATHEMATICAL DAD STRETCHED FORM ≈ <font> 0627 ا 0636 ض
ظا			MATHEMATICAL ZAH STRETCHED FORM ≈ <font> 0627 ا 0638 ظ
غا			MATHEMATICAL GHAIN STRETCHED FORM ≈ <font> 0627 ا 063A غ

Table 16: Stretched form of alphabetic symbols

ٱ	ٱ	MATHEMATICAL ALEF LOOPED FORM
		≈ \<font\> \<isolated\> 0627 ا Arabic letter alef
ٮ	ٮ	MATHEMATICAL BEH LOOPED FORM
		≈ \<font\> \<isolated\> 0628 ب Arabic letter beh
ح	ح	MATHEMATICAL JEEM LOOPED FORM
		≈ \<font\> \<isolated\> 062C ج Arabic letter jeem
د	د	MATHEMATICAL DAL LOOPED FORM
		≈ \<font\> \<isolated\> 062F د Arabic letter dal
ھ	ھ	MATHEMATICAL HEH LOOPED FORM
		≈ \<font\> \<isolated\> 0647 ه Arabic letter heh
و	و	MATHEMATICAL WAW LOOPED FORM
		≈ \<font\> \<isolated\> 0648 و Arabic letter waw
ں	ں	MATHEMATICAL ZAIN LOOPED FORM
		≈ \<font\> \<isolated\> 0632 ز Arabic letter zain
ح		MATHEMATICAL HAH LOOPED FORM
		≈ \<font\> \<isolated\> 062D ح Arabic letter hah
ط	ط	MATHEMATICAL TAH LOOPED FORM
		≈ \<font\> \<isolated\> 0637 ط Arabic letter tah
ى	ى	MATHEMATICAL YEH LOOPED FORM
		≈ \<font\> \<isolated\> 064A ي Arabic letter yeh
ک	ک	MATHEMATICAL KAF LOOPED FORM
		≈ \<font\> \<isolated\> 0643 ك Arabic letter kaf
لو	لو	MATHEMATICAL LAM LOOPED FORM
		≈ \<font\> \<isolated\> 0644 ل Arabic letter lam
م	م	MATHEMATICAL MEEM LOOPED FORM
		≈ \<font\> \<isolated\> 0645 م Arabic letter meem
ں	ں	MATHEMATICAL NOON LOOPED FORM
		≈ \<font\> \<isolated\> 0646 ن Arabic letter noon
س	س	MATHEMATICAL SEEN LOOPED FORM
		≈ \<font\> \<isolated\> 0634 س Arabic letter seen
ع	ع	MATHEMATICAL AIN LOOPED FORM
		≈ \<font\> \<isolated\> 0639 ع Arabic letter ain
ڡ	ڡ	MATHEMATICAL FEH LOOPED FORM
		≈ \<font\> \<isolated\> 0641 ف Arabic letter feh
صو	صو	MATHEMATICAL SAD LOOPED FORM
		≈ \<font\> \<isolated\> 0635 ص Arabic letter sad
و	و	MATHEMATICAL QAF LOOPED FORM
		≈ \<font\> \<isolated\> 0642 ق Arabic letter qaf
ں		MATHEMATICAL REH LOOPED FORM
		≈ \<font\> \<isolated\> 0631 ر Arabic letter reh
ش		MATHEMATICAL SHEEN LOOPED FORM
		≈ \<font\> \<isolated\> 0634 ش Arabic letter sheen
ت		MATHEMATICAL TEH LOOPED FORM
		≈ \<font\> \<isolated\> 062A ت Arabic letter teh
ث		MATHEMATICAL THEH LOOPED FORM
		≈ \<font\> \<isolated\> 062B ث Arabic letter theh
خ		MATHEMATICAL KHAH LOOPED FORM
		≈ \<font\> \<isolated\> 062E خ Arabic letter khah
ذ		MATHEMATICAL THAL LOOPED FORM
		≈ \<font\> \<isolated\> 0630 ذ Arabic letter thal
ض		MATHEMATICAL DAD LOOPED FORM
		≈ \<font\> \<isolated\> 0636 ض Arabic letter dad
ظ		MATHEMATICAL ZAH LOOPED FORM
		≈ \<font\> \<isolated\> 0638 ظ Arabic letter zah
غ		MATHEMATICAL GHAIN LOOPED FORM
		≈ \<font\> \<isolated\> 063A غ Arabic letter ghain

Table 17: Looped form of alphabetic symbols

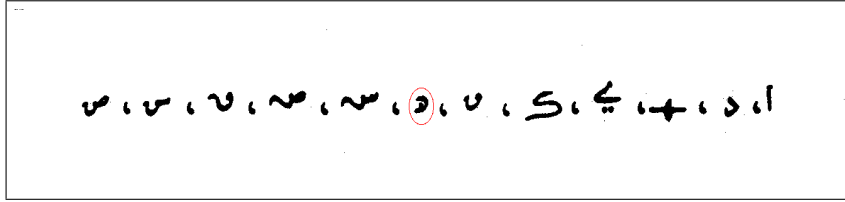| | | MATHEMATICAL ALEF DOUBLE-STRUCK FORM |
		≈ \<font\> \<isolated\> 0627 ا Arabic letter alef
		MATHEMATICAL BEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0628 ب Arabic letter beh
		MATHEMATICAL JEEM DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062C ج Arabic letter jeem
		MATHEMATICAL DAL DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062F د Arabic letter dal
		MATHEMATICAL HEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0647 ه Arabic letter heh
		MATHEMATICAL WAW DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0648 و Arabic letter waw
		MATHEMATICAL ZAIN DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0632 ز Arabic letter zain
		MATHEMATICAL HAH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062D ح Arabic letter hah
		MATHEMATICAL TAH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0637 ط Arabic letter tah
		MATHEMATICAL YEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 064A ي Arabic letter yeh
		MATHEMATICAL KAF DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0643 ك Arabic letter kaf
		MATHEMATICAL LAM DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0644 ل Arabic letter lam
		MATHEMATICAL MEEM DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0645 م Arabic letter meem
		MATHEMATICAL NOON DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0646 ن Arabic letter noon
		MATHEMATICAL SEEN DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0634 س Arabic letter seen
		MATHEMATICAL AIN DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0639 ع Arabic letter ain
		MATHEMATICAL FEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0641 ف Arabic letter feh
		MATHEMATICAL SAD DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0635 ص Arabic letter sad
		MATHEMATICAL QAF DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0642 ق Arabic letter qaf
		MATHEMATICAL REH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0631 ر Arabic letter reh
		MATHEMATICAL SHEEN DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0634 ش Arabic letter sheen
		MATHEMATICAL TEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062A ت Arabic letter teh
		MATHEMATICAL THEH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062B ث Arabic letter theh
		MATHEMATICAL KHAH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 062E خ Arabic letter khah
		MATHEMATICAL THAL DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0630 ذ Arabic letter thal
		MATHEMATICAL DAD DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0636 ض Arabic letter dad
		MATHEMATICAL ZAH DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 0638 ظ Arabic letter zah
		MATHEMATICAL GHAIN DOUBLE-STRUCK FORM
		≈ \<font\> \<isolated\> 063A غ Arabic letter ghain

Table 18: Double-struck form of alphabetic symbols

(١) أشكال الرموز الحرفية

المجموعة الممدودة	مجموعات الابتداء	المجموعات المعقوفة	المجموعات الهندسية	
			مجوفة	عادية
ٮا	ٮ	لٮ	م	ٮ
جا	ب	بٯ	ٮٮ	ج
دا	ج	ٯح	ح	د
ها	د	هد	ٯد	ه
	و	هـ	ه	و
	ر	ڹ	ٮ	ز
حا	ع	ع	ع	ع
طا	ط	ط	ط	ط
با	ٮ	ٮ	ٮ	ي
كا	ل	كه	كه	ك
لا	م	ح	ص	ل
ما	ٮ	ٮه	ٯ	م
نا	ٮ	ٮس	ٮٯ	ٮ
عا	ع	كع	عٯ	ع
فا	ٯ	ٯه	ٯٮ	ٯ
صا	م	صم	صٮ	م
قا	ٯ	ٯه	ٯ	ٯ
شا	ٮ	شه	شٮ	ش
تا	ٮ	ٮٯ	ٮ	ٮ
ثا	ٮ	ٮه	ٮ	ح
خا	خ	ح	ح	ح
	ٮ	ٮه	ٯ	ٯ
ضا	ص	صد	صٮ	ص
ظا	ظ	ظ	ظ	ظ
غا	غ	غ	غ	غ

Figure 2: Basic mathematical alphabetic symbols in Amman Convention [1.1]

ا ، د ، ٮـ ، ‍ي ، ‍ک ، �‍ں ، (ه) ، ‍ں ، ‍ص ، ‍س ، ‍ں ، ‍ں ، ‍ص

Figure 3: Particular mathematical alphabetic symbols in Amman Convention [1.1]
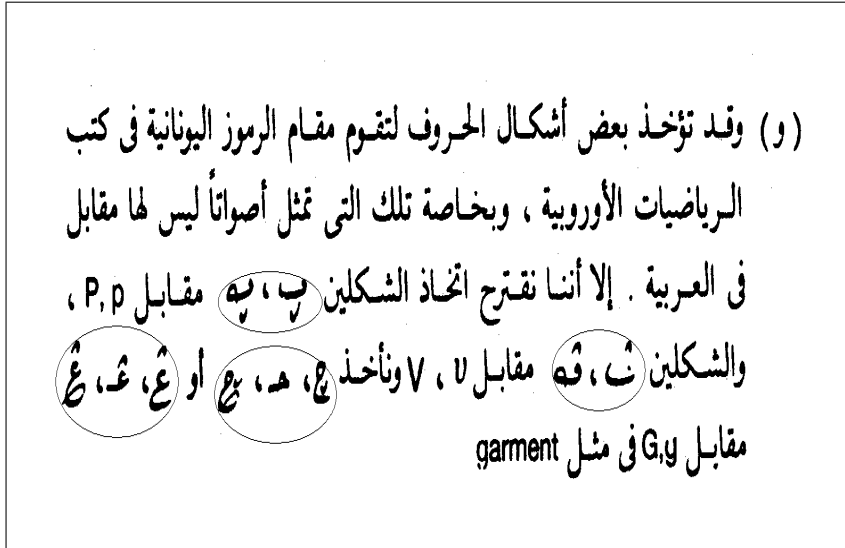
(و) وقد تؤخذ بعض أشكال الحروف لتقـوم مقـام الرمـوز اليونانية فى كتب الرياضيات الأوروبية ، وبخـاصة تلك التى تمثل أصواتاً ليس لها مقابل فى العربية . إلا أننـا نقـترح اتخـاذ الشكلين ‍پ، ‍په مقـابل P,p ، والشكلين ‍ث، ‍ثه مقابل V ، ونأخـذ ‍ج، هـ، بج أو غ، ثـ، غ مقابل G,y فى مثل garment

Figure 4: Exceptional mathematical alphabetic symbols in Amman Convention [1.1]

‍ء٘ = ‍ء — = ‍ء٘ مجموعة مكملة إشارات ، ، – ، (ك)
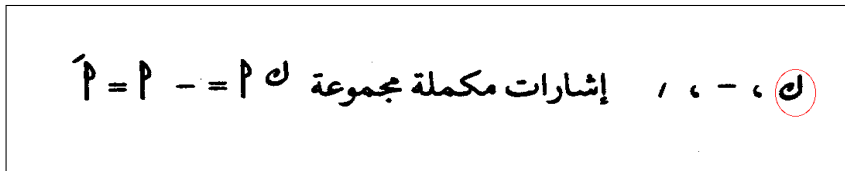
Figure 5: Complement symbol in Amman Convention [1.1]

إشارة التساوى حسب التعريف : ‍ا٘ ‍ا٘ هـ . (‍نى)
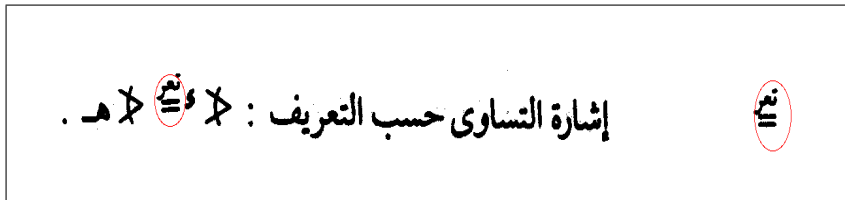
Figure 6: Equal by definition symbol in Amman Convention [1.1]

إشارة جمع ن من الحدود (‍حـٮ٘)
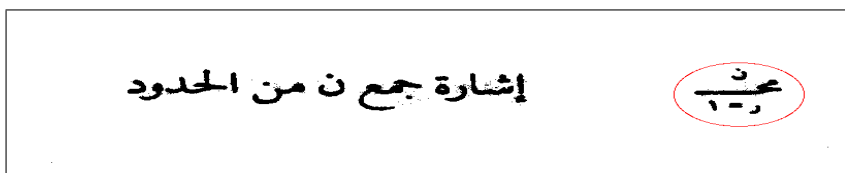
Figure 7: Conventionnal summation operator in Amman Convention [1.1]

إشارة ضرب عدة عوامل ينتظمها قانون واحد :

$$\prod_{ر=1}^{ن} ا_ر = ا_1 . ا_2 . ا_3 \ldots ا_ن$$
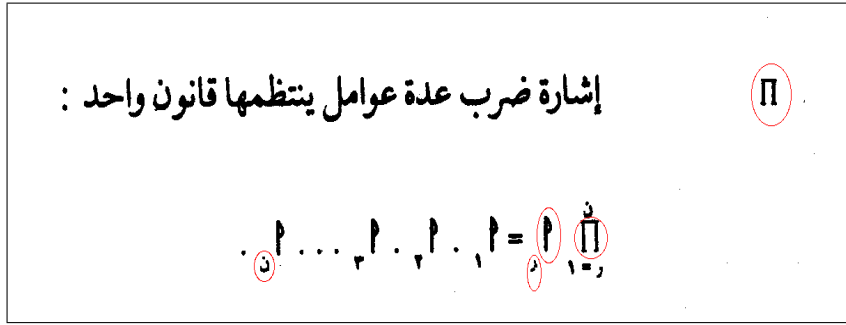
Figure 8: Product operator

إشارتا المضروب ، مثلاً ٣ ! = ٣×٢×١ = لــ٣   ، !
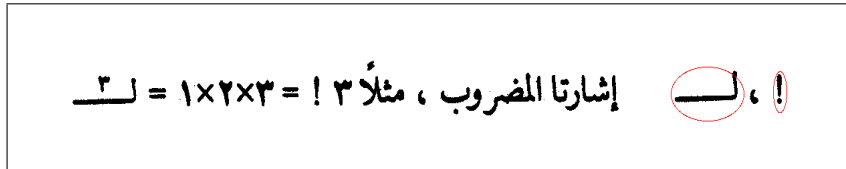
Figure 9: Conventionnal factorial symbol in Amman Convention [1.1]

يسمى جداء ھ من الأعداد الطبيعية الأولى عاملي ھ ونرمز اليه بالرمز ھ!
لــكي يكون التطبيق ھ ⟵ ھ ! معرفا فى ھ | ھ !
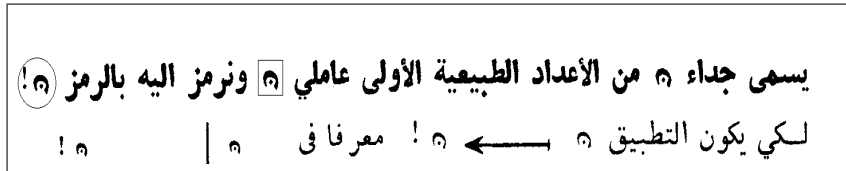
Figure 10: Factorial symbol in Handbook [3.12]

ل = نهــا ا (س) ، ل = نها ا (س) ، ل = نهــا ا (س)

ل = نهــا ا (س) ، ل = نها ا (س) .
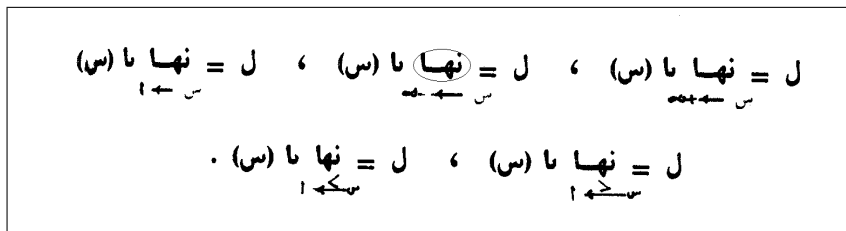
Figure 11: Conventionnal limit symbol in Handbook [3.12]

$$ق_{ھ}^{ھ} = \dfrac{ھ!}{(ھ - ھ)! \; ھ!}$$
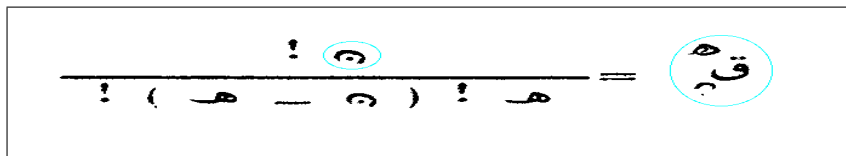
Figure 12: Heh symbol in Handbook [3.12]

الكسر
ولو رمزنا الى مجموعة الاعداد النسبية بالرمز ﮎ   فان :

$$ﮎ = \left\{ \dfrac{ا}{ب} : ا \text{ عدد صحيح } ، ب \text{ عدد صحيح } ، ب \neq \text{صفر} \right\}$$
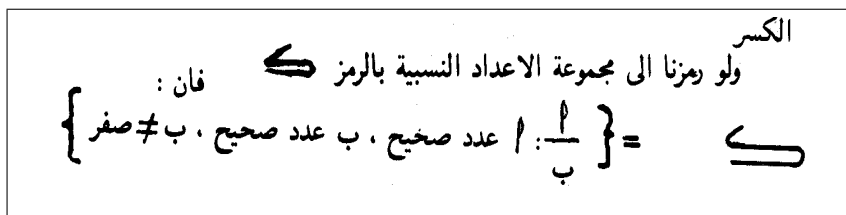
Figure 13: Swash kaf symbol in Handbook [3.11]

$$٩ \ (\ م \ ) \quad \boxed{ج} + م)^{٢} \quad - \quad (\ \frac{١}{١٠٠} \ \underset{..}{-} \ \underset{.}{-} \ ) \quad د \ )^{٢}$$
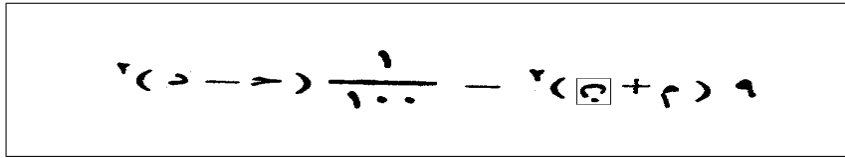
Figure 14: Inverted noon symbol in Handbook [3.2]

st (F)	open star of F	نجم ڧ المفتوح	ن (ڧ)
St (F)	closed star of F	نجم ڧ المغلق	م (ڧ)

Figure 15: Noon and inverted noon symbol in Amman convention [1.1]

الرموز المستعملة في الهندسة :

يرد في الهندسـة النظريـة عبارات يتكـرر استخدامها كثيرا لذلك يستعاض عنها برموز خاصة سنورد أهمها فيما يلي :

مدلوله	الرمز	مدلوله	الرمز
زاوية قائمة	قا	زاوية	⌒
نصف قطر دائرة	نق	مثلث	△
اذن	∴	مثلثان	△△
بما أن	∵	عمود على	⊥
اكبر من	<	يوازى	//
أصغر من	>	لا يساوى	≠
		قوس	⌒

Figure 16: Some symbols in Handbook [3.2]
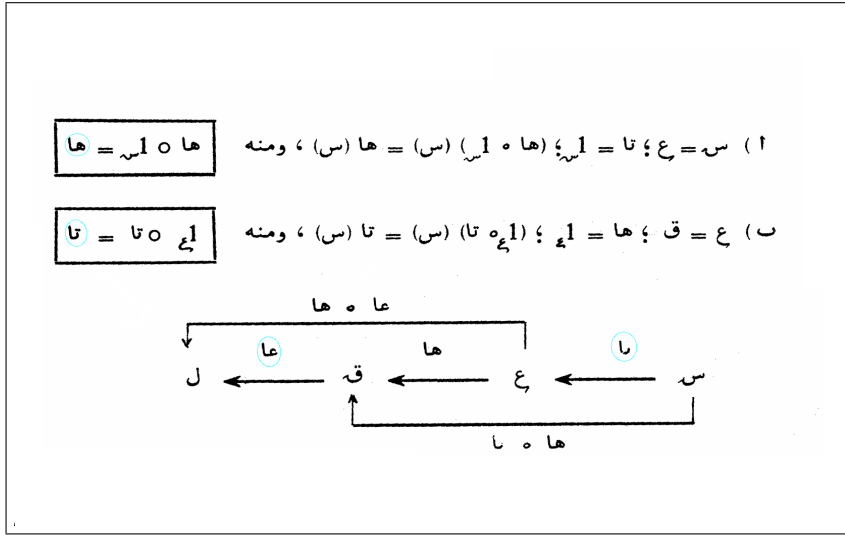
Figure 17: Stretched symbols in Handbook [3.12]

Figure 18: Dot-less symbols in Handbook [3.12]

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27 — المقدار الجبرى :

عندما ترتبط بمجموعة من الأعداد بعملية أو أكثر من عمليات الجمع والطرح والضرب و . . . يقال أنها تكون ، مقداراً جبرياً ، ، وهذه الأعداد قد تكون كلها أو بعضها مجهول القيمة ، ولذا يرمز لها بحروف هجائية . فثلا :

$$8 \text{ س ص}^2 \quad , \quad \frac{5 \text{ س}^2 - 3 \text{ ص}^2}{\text{س}^2 - 4 \text{ ص}} \quad , \quad \text{س}^2 - 5 \text{ س ص} + 7 \text{ ع}$$

$$\sqrt{\text{س}^2 - 5} - \text{س } 2$$

عبارة عن مقادير جبرية .   أى أن :

، المقدار الجبرى عبارة عن بمجموعة من الأعداد — المعبر عن بعضها أو كلها بحروف — مرتبطة من بعضها بعملية أو أكثر . ،

كل حرف يدخل فى تكوين المقدار الجبرى يمثل عدداً واحداً وإن تكرر فيه أكثر من مرة ، أما إذا اشتمل المقدار الجبرى على حرف واحد فى صورتين مختلفتين كما فى القانون الذى نستخدمه فى إيجاد مساحة الحلقة الدائرية :

$$\text{ح} = \text{ط } (\text{سم}^2 - \text{ش}^2)$$

حيث ح المساحة ، سم شعاع (نصف قطر) الدائرة الخارجية ، ش شعاع الدائرة الداخلية .

فإنه يكون لكل منها قيمة تختلف عن الآخر .

ملاحظة : كثيراً ما ترمز للمقدار الجبرى بحرف واحد لا يكون ضمن المقدار ،

Figure 19: Alphabetical symbols in Handbook [3.5]

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كتابة التضعيفات بالنسبة لليتر وقراءتها :

ُنلاحظ مما تقدم ان تضعيفات الليتر تكبر الوحدة الاساسية بعشر مرات او بمئة مرة او بالف مرة، وان اجزاء الليتر تصغر الوحدة الاساسية بعشر مرات او بمئة مرة او بالف مرة ، اي انها تتبع في نظامها النظام العشري . وهي لذلك لا تختلف في كتابتهـا وقراءتها عن كتابة الاعداد الصحيحة والعشرية وقراءتها . مثال ذلك : ٧ هكل ٦ دكل ٣ ل ٥ سل ٥ ملل .

هكل	دكل	ل	فواصل	دسل	سل	ملل
٧	٦	٣	،	٠	٥	٤

تكتب :

وُتقرأ :
سبعمئة وثلاثة وستينليتراً واربعة وخمسين من الف.

Figure 20: Litre unites symbols in Handbook [3.6]

(197) قطعة من القماش طولها 36 م ، يبيع منها 13,5 م ، فما نسبة طول القطعة الباقية إلى طول القطعة كلها ؟

(198) قطعة أرض مساحتها 3 هكتار و 72 آر و 25 سنتي آر ، يبيع منهـا جزء قـدره 14754 م٢ . أوجــــد النسبة بين مساحـة الجزء البـاقي والمساحة الأصلية .

(199) زاويتان قيمتاهما 30َ 25° ، 43,25 جراد . فـما نسبة الثانية إلى الأولى ؟

(200) قطاران أولهما سرعته 50 كلم/س والثانى يقطع 450 كلم فى 7 س و 25 د . فما النسبة بين سرعتيهما ؟

(201) مخروط وأسطوانة متساويان فى شعـاع (نصف قطر) القاعـدة والارتفاع . أوجــــد النسبة بين حجم المخروط (ح) وحجم الأسطوانة (حَ) .

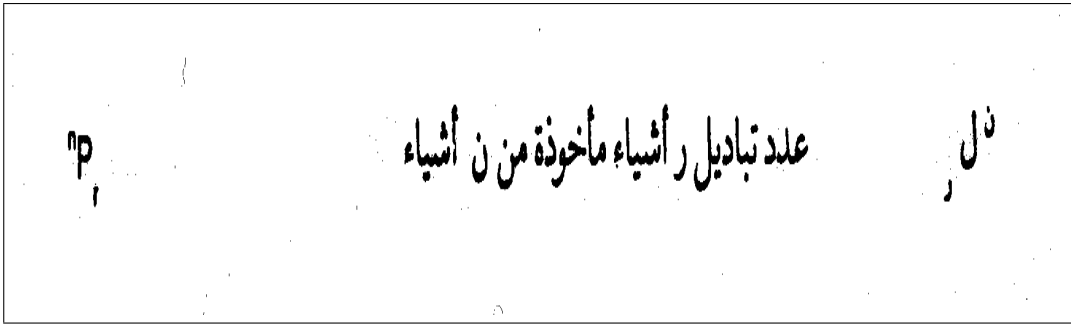Figure 21: Length unites symbols in Handbook [3.6]

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$$^{n}P_{r} \qquad \text{عدد تباديل ر أشياء مأخوذة من ن أشياء}$$

Figure 22: Arrangement symbol in Amman Convention [1.1]

(١) **التـبـديل** : هو ترتيب لعدة أشياء مختلفة بأخذها كلها أو بعضها فى كل مرة.

(٢) الرمز $^{ه}ل_{ر}$ ، ويقرأ «ه لام ر» ، يدل على عدد تباديل ه من الأشياء المختلفة مأخوذ منها ر من الأشياء فى كل مرة حيث ر ≤ ه أى أن :

$^{ه}ل_{ر}$ = عدد الترتيبات (أو الأوضاع المختلفة) التى يمكن تكوينها من ه من الأشياء بحيث يحتوى كل ترتيب على ر من هذه الأشياء .
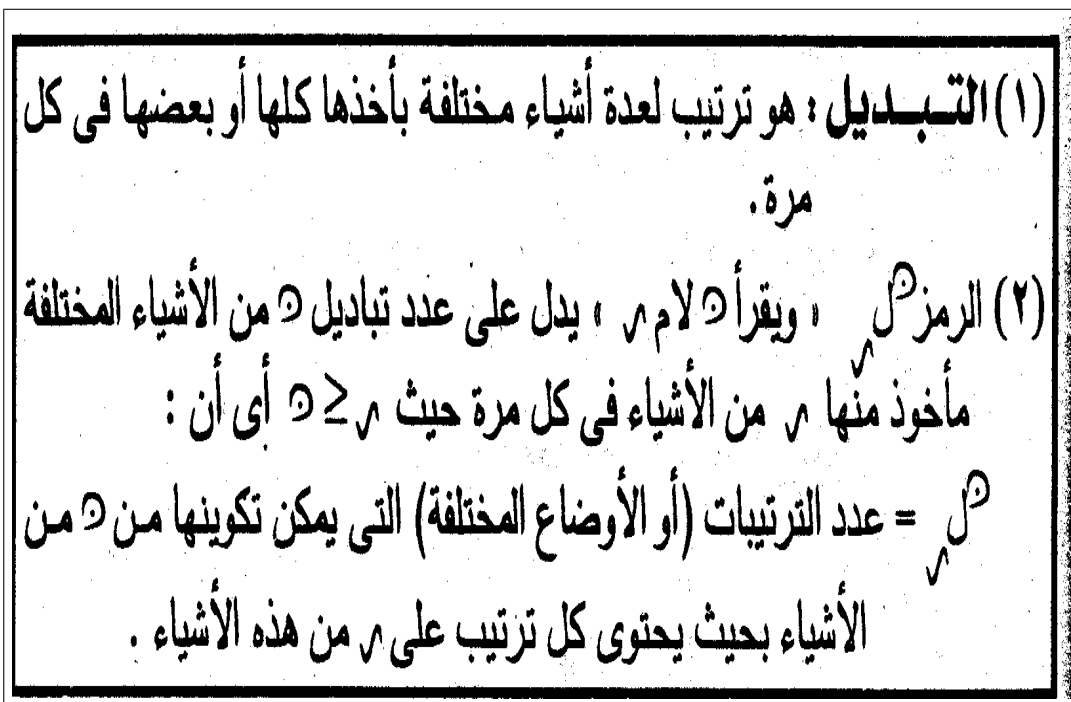
Figure 23: Arrangement symbol in Handbook

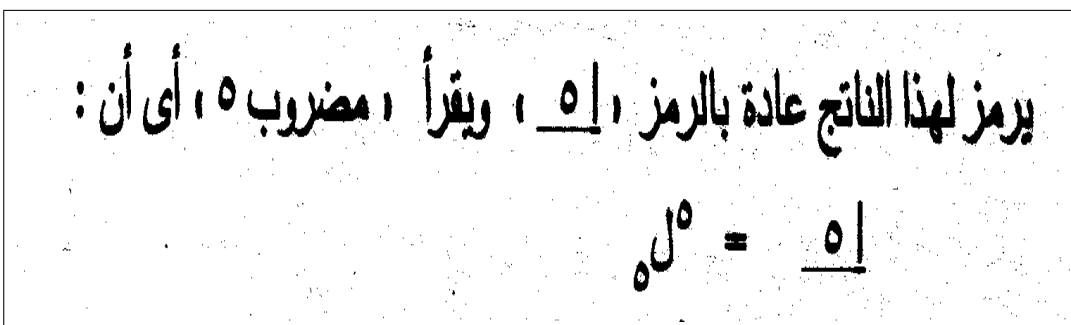يرمز لهذا الناتج عادة بالرمز « ه| » ، ويقرأ « مضروب ه » ، أى أن :

$$\underline{\text{ه}} \; = \; ^{ه}ل_{ه}$$

Figure 24: Factorial symbol in Handbook