

Arabic Mathematical Alphabetic Symbols, Additional characters proposed to Unicode

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March 26, 2006

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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 though 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* [11]. *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, used Moroccan handbooks 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 [4] show both modern printed editions (with the **RyDArab** system [6]) 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 current Arabic mathematical expressions [10]. 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 [5]. Some other proposals can be found in [4].

The addition of these characters can be done to the existing blocks: Letterlike symbols and Mathematical alphanumeric symbols. As there is not enough room in these existing blocks, we should ask for new blocks.

The **RamzArab** font available, includes all these characters. It's in OpenType format, for publication of the standard [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.

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, or ligaturing, of Arabic letters is omitted in mathematical mode except for abbreviations or units entities like trigonometric function names.

The basic mathematical alphabetic letterlike symbols used in Arabic mathematical handbooks are of six forms [3]: *isolated*, *initial*, *tailed*, *stretched*, *looped*, and *double-struck* (see Table 1).

With a close variation to the shapes, certain forms of these characters already exist in the Unicode standard. In particular, the isolated and the initial forms of the Arabic letters are codified in "Arabic Presentation Forms-B" block but used in natural text. As we consider used them in mathematical mode, we can propose them here to be include in the Unicode Standard. That will facilitate the use of MathML for Arabic mathematical presentation [3].

For some characters in the basic set of Arabic characters, more than one variant of the same character are asked for inclusion. This is because they can appear in the same mathematical document with different meanings, even though they would have the same meaning in Arabic text. This is what happen with Latin and Greek characters [2].

The isolated form is the form most frequently used. In absence of specification of form, the isolated form is that which will be considered. 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.

There are two alphabetic orders in Arabic. The one used in mathematics or alphabetic numeration list is the a, b, j, d, \dots (namely ا, ب, ج, د, \dots) order (see Figure 2). It differs from the a, b, t, th, \dots (namely ا, ب, ت, ث, \dots)

ج	MATHEMATICAL JEEM
	≈ 062C ج Arabic letter jeem
ج	MATHEMATICAL INITIAL JEEM
	≈ <initial> 062C ج Arabic letter jeem
	≈ FE9F ج Arabic letter jeem initial form
ج	MATHEMATICAL TAILED JEEM
	≈ FE9F ج 06C1 ~
جا	MATHEMATICAL STRETCHED JEEM
	≈ FE9F ج FE8E ل
ج	MATHEMATICAL LOOPED JEEM
	≈ 062C ج Arabic letter jeem
ج	MATHEMATICAL DOUBLE-STRUCK JEEM
	≈ 062C ج Arabic letter jeem

Table 1: Example of mathematical alphabetic symbols

...) order usually adopted in modern dictionaries.

The glyphs of the letters ALEF¹, 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 the Table 2, the mathematical alphabetic symbols are presented with dots in the *a-b-j-d* order.

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

The glyph of the letter ALEF ا can be confused with the Arabic-Indic

¹All 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
—	ه	ه	ه	ه	ه
—	و	و	و	و	و
—	ز	ز	ز	ز	ز
—	ح	ح	ح	ح	ح
—	ط	ط	ط	ط	ط
—	ث	ث	ث	ث	ث
—	ج	ج	ج	ج	ج
—	ب	ب	ب	ب	ب
—	ا	ا	ا	ا	ا

Table 2: Mathematical basic alphabetic symbols

digit ONE ١. Thus, it's replaced by ا. 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 ه. 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 ك or ك. The glyph of the letter NOON can be found in different orientation and styles, with and without dot, (ن, ن, ن, ن, ن, ن, ن, ن, ن, ن) according to the local area (see Figure 14 and Figure 15).

ا	MATHEMATICAL ALEF ALHISAB ≈ 0627 Arabic letter alef
،	MATHEMATICAL SHARAT KAF
ه	MATHEMATICAL HEH MASHQUQAT ≈ FEED ه FE73 ل
ك	MATHEMATICAL KAF RUQAAT
م	MATHEMATICAL MEEM MURSALAT ≈ 0645 م Arabic letter meem
ن	MATHEMATICAL INVERTED NOON ≈ 0646 ن Arabic letter noon
ر	MATHEMATICAL REH MODGHAMAT ≈ 0631 ر Arabic letter reh
ز	MATHEMATICAL ZAIN MODGHAMAT ≈ 0632 ز Arabic letter zain
ى	MATHEMATICAL LOOPED ALEF MAKSURA ≈ 0649 ى Arabic letter alef maksura

Table 3: Mathematical particular alphabetic symbols

ا	MATHEMATICAL DOUBLE-STRUCK ALEF ALHISAB ≈ 0627 Arabic letter alef
ك	MATHEMATICAL DOUBLE-STRUCK SHARAT KAF
ه	MATHEMATICAL DOUBLE-STRUCK HEH MASHQUQAT ≈ FEEB ه FE73 ح
ي	MATHEMATICAL DOUBLE-STRUCK YEH RAJIAT ≈ 06D2 ي Arabic letter yeh barree
ك	MATHEMATICAL DOUBLE-STRUCK KAF RUQAAT
ك	MATHEMATICAL DOUBLE-STRUCK KAF ZIDANY ≈ 06AA ك Arabic letter swash kaf
لا	MATHEMATICAL DOUBLE-STRUCK LAMALEF ≈ FEFB لا Arabic ligature lam with alef
م	MATHEMATICAL DOUBLE-STRUCK MEEM MURSALAT ≈ 0645 م Arabic letter meem
ن	MATHEMATICAL DOUBLE-STRUCK INVERTED NOON ≈ 0646 ن Arabic letter noon
ر	MATHEMATICAL DOUBLE-STRUCK REH MODGHAMAT ≈ 0631 ر Arabic letter reh
ز	MATHEMATICAL DOUBLE-STRUCK ZAIN MODGHAMAT ≈ 0632 ز Arabic letter reh
ا	MATHEMATICAL DOUBLE-STRUCK ALEF MAKSURA ≈ 0649 ا Arabic letter alef maksura
ء	MATHEMATICAL DOUBLE-STRUCK HAMZA ≈ 0621 ء Arabic letter hamza

Table 4: Mathematical double-struck particular alphabetic symbols

4 Special mathematical alphabetic symbols

In order to avoid ambiguities, the Arabic character types used in mathematics are frequently based on dotless letters (see Figure 18). As some Arabic letters differ only by the addition of dots below or above basic symbols, the basic *dotless* symbols list is smaller than the complete list of the alphabet. Moreover, care should be taking in naming the ambiguous dotless letterlike symbols (see Table 5).

On the other hand, in order to provide a big amount of symbols in use, to satisfy both local area using dotless 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 6), the special mathematical alphabetical symbols without dots are presented.

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

Table 5: Dotless letterlike symbols ambiguous names

ب	MATHEMATICAL TAILED DOTLESS BEH
	≈ FBE8 ۛ 06C1 ب
ب	MATHEMATICAL STRETCHED DOTLESS BEH
	≈ FBE8 ۛ FE8E ب
ب	MATHEMATICAL LOOPED DOTLESS BEH
	≈ 066E ب Arabic letter dotless beh
ب	MATHEMATICAL DOUBLE-STRUCK DOTLESS BEH
	≈ 066E ب Arabic letter dotless beh
ف	MATHEMATICAL TAILED DOTLESS FEH
ف	MATHEMATICAL STRETCHED DOTLESS FEH
ف	MATHEMATICAL LOOPED DOTLESS FEH
	≈ 066F ف Arabic letter dotless feh
ف	MATHEMATICAL DOUBLE-STRUCK DOTLESS FEH
	≈ 066F ف Arabic letter dotless feh
ن	MATHEMATICAL DOTLESS INVERTED NOON
	≈ 06BA ۞ Arabic letter noon ghunna
ن	MATHEMATICAL DOUBLE-STRUCK DOTLESS INVERTED NOON
	≈ 06BA ۞ Arabic letter noon ghunna

Table 6: Mathematical dotless alphabetic symbols

5 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 7).

پ̂	MATHEMATICAL LOOPED PEH ≈ 067E پ̂ Arabic letter peh
ت̂	MATHEMATICAL LOOPED TCHEH ≈ 0686 ت̂ Arabic letter tch eh
ف̂	MATHEMATICAL LOOPED VEH ≈ 06A4 ف̂ Arabic letter veh
ع̂	MATHEMATICAL LOOPED GHEH ≈ 06A0 ع̂ Arabic letter ain with tree dots above

Table 7: Mathematical exceptional alphabetic symbols

6 Large mathematical alphabetic symbols

The Arabic n-ary summation operator is denoted by either \sum and \sum symbols according to the local area (see Figure 7 and Table 8).

The Arabic n-ary product operator is denoted by either \prod and \prod symbols according to the local area (see Figure 8 and Table 8).

The Arabic limit operator is denoted by \lim symbol (see Table 8).

The Arabic factorial operator is denoted by either $!$ and $!$ symbols according to the local area (see Figure 9 and Table 8).

Those mathematical operators derived from Arabic characters are proposed to proper encodings because they are used differently than the corresponding letters. These operators may occasionally occur in context with Arabic-letter variables. Those characters are large operators that take limit expressions [2].

The symbols Summation, Product and Limit can be denoted with dots (\sum , \prod and \lim) or without dots (\sum , \prod and \lim).

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 T_EX or MathML, can be help to 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

مجم	ARABIC LARGE N-ARY SUMMATION \approx FCCE مجم Arabic ligature meem with jeem initial form
جد	ARABIC LARGE N-ARY PRODUCT \approx FE9F جد FEAA جد Arabic ligature jeem with thal
نها	ARABIC LARGE LIMIT \approx FCD6 نها FEBE نها
ل	ARABIC LARGE FACTORIAL \approx FEDF ل Arabic letter lam initial form

Table 8: Mathematical large symbols

مح	ARABIC DOTLESS LARGE N-ARY SUMMATION \approx FCCF مح Arabic ligature meem with hah initial form
حد	ARABIC DOTLESS LARGE N-ARY PRODUCT \approx FEA3 حد FEAA حد
ها	ARABIC DOTLESS LARGE LIMIT

Table 9: Mathematical dotless large symbols

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).

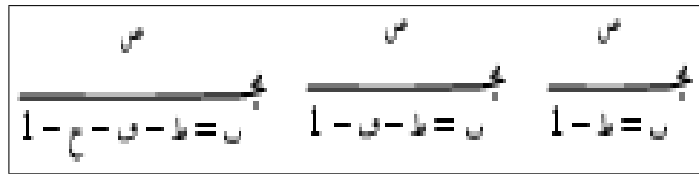


Figure 1: Variable-sized conventional summation operator

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 [7] [10]. 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.

7 Added basic character names

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

- Arabic mathematical tailed alphabetic symbols (see Table 13);
- Arabic mathematical stretched alphabetic symbols (see Table 14);
- Arabic mathematical looped alphabetic symbols (see Table 15);
- Arabic mathematical double-struck alphabetic symbols (see Table 16).

8 Unified others character names

The initial and isolated characters and all the other characters from existing characters, from the presentation forms blocks are supposed to retain their shape during rendering, exactly as is required by mathematical use. Therefore, they will be unified.

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

- Arabic mathematical isolated alphabetic symbols (see Table 10);
- Arabic mathematical initial alphabetic symbols (see Table 11);
- Arabic mathematical others alphabetic symbols (see Table 12).

References

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

Table 10: Mathematical isolated alphabetic symbols

ب	MATHEMATICAL INITIAL BEH Unified with <initial> 0628 ب Arabic letter beh Unified with FE91 ب Arabic letter beh initial form
ج	MATHEMATICAL INITIAL JEEM Unified with <initial> 062C ج Arabic letter jeem Unified with FE9F ج Arabic letter jeem initial form
هـ	MATHEMATICAL INITIAL HEH Unified with <initial> 0647 هـ Arabic letter heh Unified with FEEB هـ Arabic letter heh initial form
ح	MATHEMATICAL INITIAL HAH Unified with <initial> 062D ح Arabic letter hah Unified with FE A3 ح Arabic letter hah initial form
ي	MATHEMATICAL INITIAL YEH Unified with <initial> 064A ي Arabic letter yeh Unified with FEF3 ي Arabic letter yeh initial form
ك	MATHEMATICAL INITIAL KAF Unified with <initial> 0643 ك Arabic letter kaf Unified with FEDB ك Arabic letter kaf initial form
ل	MATHEMATICAL INITIAL LAM Unified with <initial> 0644 ل Arabic letter lam Unified with FEDF ل Arabic letter lam initial form
م	MATHEMATICAL INITIAL MEEM Unified with <initial> 0645 م Arabic letter meem Unified with FEE3 م Arabic letter meem initial form
ن	MATHEMATICAL INITIAL NOON Unified with <initial> 0646 ن Arabic letter noon Unified with FEE7 ن Arabic letter noon initial form
س	MATHEMATICAL INITIAL SEEN Unified with <initial> 0634 س Arabic letter seen Unified with FEB3 س Arabic letter seen initial form
ع	MATHEMATICAL INITIAL AIN Unified with <initial> 0639 ع Arabic letter ain Unified with FECB ع Arabic letter ain initial form
ف	MATHEMATICAL INITIAL FEH Unified with <initial> 0641 ف Arabic letter feh Unified with FED3 ف Arabic letter feh initial form
ص	MATHEMATICAL INITIAL SAD Unified with <initial> 0635 ص Arabic letter sad Unified with FEBB ص Arabic letter sad initial form
ق	MATHEMATICAL INITIAL QAF Unified with <initial> 0642 ق Arabic letter qaf Unified with FED7 ق Arabic letter qaf initial form
ش	MATHEMATICAL INITIAL SHEEN Unified with <initial> 0634 ش Arabic letter sheen Unified with FEB7 ش Arabic letter sheen initial form
ت	MATHEMATICAL INITIAL TEH Unified with <initial> 062A ت Arabic letter teh Unified with FE97 ت Arabic letter teh initial form
ث	MATHEMATICAL INITIAL THEH Unified with <initial> 062B ث Arabic letter theh Unified with FE9B ث Arabic letter theh initial form
خ	MATHEMATICAL INITIAL KHAH Unified with <initial> 062E خ Arabic letter khah Unified with FE A7 خ Arabic letter khah initial form
ض	MATHEMATICAL INITIAL DAD Unified with <initial> 0636 ض Arabic letter dad Unified with FEBF ض Arabic letter dad initial form
غ	MATHEMATICAL INITIAL GHAIN Unified with <initial> 063A غ Arabic letter ghain Unified with FECF غ Arabic letter ghain initial form

Table 11: Mathematical initial alphabetic symbols

ﻉ	MATHEMATICAL YEH RAJIAT Unified with 06D2 ﻉ Arabic letter yeh barree
ﻙ	MATHEMATICAL KAF ZIDANY Unified with 06AA ﻙ Arabic letter swash kaf
ﻻ	MATHEMATICAL LAMALEF Unified with FEFB ﻻ Arabic ligature lam with alef
ﻯ	MATHEMATICAL ALEF MAKSURA Unified with 0649 ﻯ Arabic letter alef maksura
ﺀ	MATHEMATICAL HAMZA Unified with 0621 ﺀ Arabic letter hamza
ﺏ	MATHEMATICAL DOTLESS BEH Unified with 066E ﺏ Arabic letter dotless beh
ﺪ	MATHEMATICAL INITIAL DOTLESS BEH Unified with FBE8 ﺪ Arabic letter Uighur Kazakh Kirghiz alef maksura initial form
ﻑ	MATHEMATICAL DOTLESS FEH Unified with 066F ﻑ Arabic letter dotless feh
ﻭ	MATHEMATICAL INITIAL DOTLESS FEH
ﭗ	MATHEMATICAL PEH Unified with 067E ﭗ Arabic letter peh
ﺡ	MATHEMATICAL TCHEH Unified with 0686 ﺡ Arabic letter tcheh
ﻑ	MATHEMATICAL VEH Unified with 06A4 ﻑ Arabic letter veh
ﻎ	MATHEMATICAL GHEH Unified with 06A0 ﻎ Arabic letter ain with tree dots above

Table 12: Mathematical others alphabetic symbols

ب	MATHEMATICAL TAILED BEH ≈ 0628 ب06C1 ~
ج	MATHEMATICAL TAILED JEEM ≈ 062C ج 06C1 ~
ه	MATHEMATICAL TAILED HEH ≈ 0647 ه 06C1 ~
ح	MATHEMATICAL TAILED HAH ≈ 062D ح 06C1 ~
ط	MATHEMATICAL TAILED TAH ≈ 0637 ط06C1 ~
ي	MATHEMATICAL TAILED YEH ≈ 064A ي06C1 ~
ك	MATHEMATICAL TAILED KAF ≈ 0643 ك 06C1 ~
ل	MATHEMATICAL TAILED LAM ≈ 0644 ل 06C1 ~
م	MATHEMATICAL TAILED MEEM ≈ 0645 م 06C1 ~
ن	MATHEMATICAL TAILED NOON ≈ 0646 ن 06C1 ~
س	MATHEMATICAL TAILED SEEN ≈ 0634 س 06C1 ~
ع	MATHEMATICAL TAILED AIN ≈ 0639 ع 06C1 ~
ف	MATHEMATICAL TAILED FEH ≈ 0641 ف06C1 ~
ص	MATHEMATICAL TAILED SAD ≈ 0635 ص 06C1 ~
ق	MATHEMATICAL TAILED QAF ≈ 0642 ق06C1 ~
ش	MATHEMATICAL TAILED SHEEN ≈ 0634 ش 06C1 ~
ت	MATHEMATICAL TAILED TEH ≈ 062A ت 06C1 ~
ث	MATHEMATICAL TAILED THEH ≈ 062B ث 06C1 ~
خ	MATHEMATICAL TAILED KHAH ≈ 062E خ 06C1 ~
ض	MATHEMATICAL TAILED DAD ≈ 0636 ض 06C1 ~
ظ	MATHEMATICAL TAILED ZAH ≈ 0638 ظ 06C1 ~
غ	MATHEMATICAL TAILED GHAIN ≈ 063A غ 06C1 ~

Table 13: Mathematical tailed alphabetic symbols

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

Table 14: Mathematical stretched alphabetic symbols

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

Table 15: Mathematical looped alphabetic symbols

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

Table 16: Mathematical double-struck alphabetic symbols

(١) أشكال الرموز الحرفية

المجموعات الهندسية	المجموعات المعقوفة	مجموعات الابتداء	المجموعة الممدودة
عادية	مجموعه		
<p> α β γ δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω </p>	<p> α β γ δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω </p>	<p> α β γ δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω </p>	<p> α β γ δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω δ ϵ ζ η θ ι κ λ μ ν ξ \omicron π ρ σ τ υ ϕ χ ψ ω </p>

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

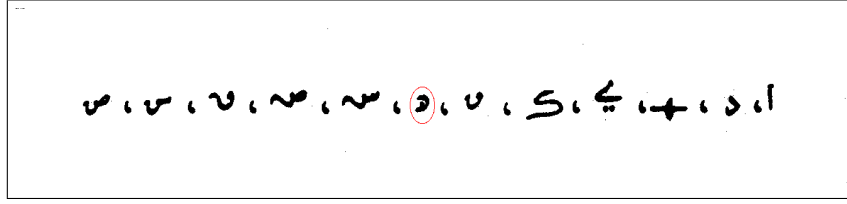


Figure 3: Particular mathematical alphabetic symbols in Amman Convention [1.1]

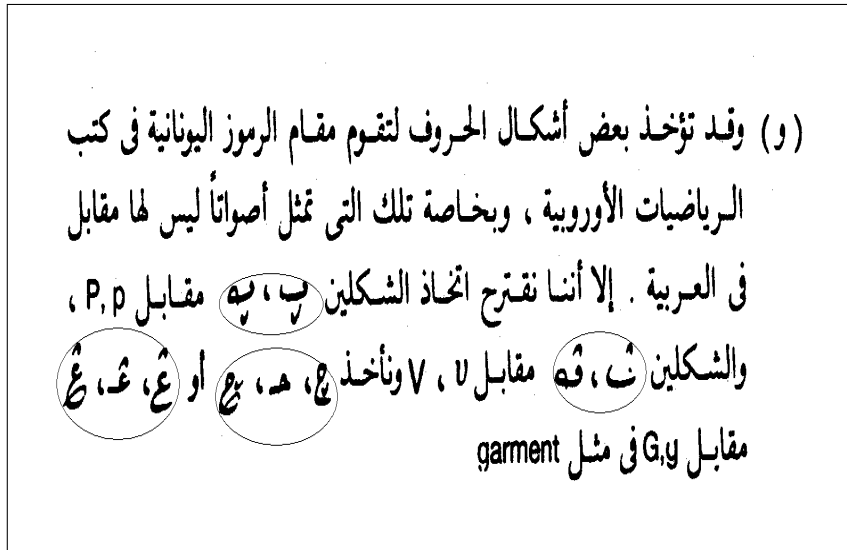


Figure 4: Exceptional mathematical alphabetic symbols in Amman Convention [1.1]

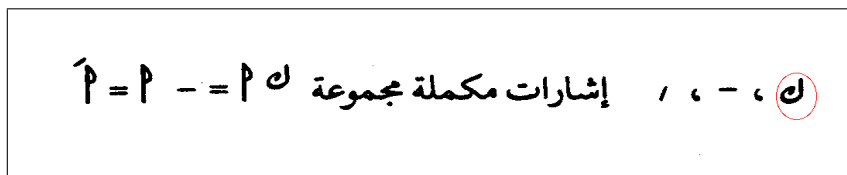


Figure 5: Complement symbol in Amman Convention [1.1]

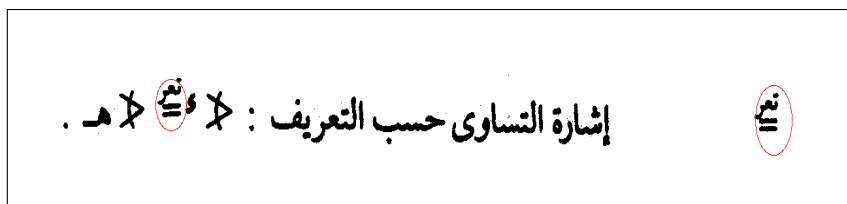


Figure 6: Equal by definition symbol in Amman Convention [1.1]

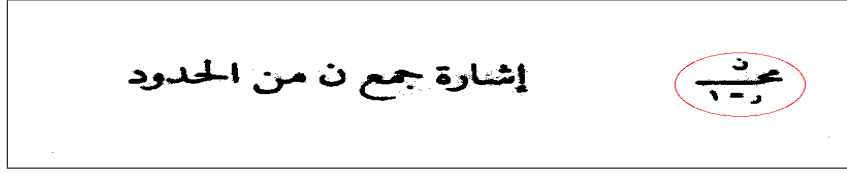


Figure 7: Conventional summation operator in Amman Convention [1.1]

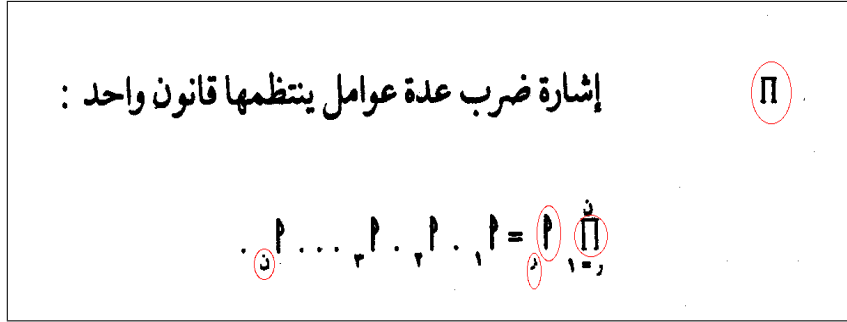


Figure 8: Product operator

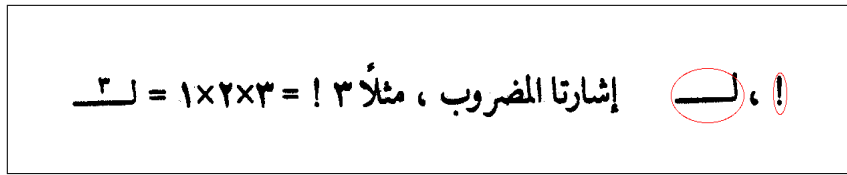


Figure 9: Conventional factorial symbol in Amman Convention [1.1]

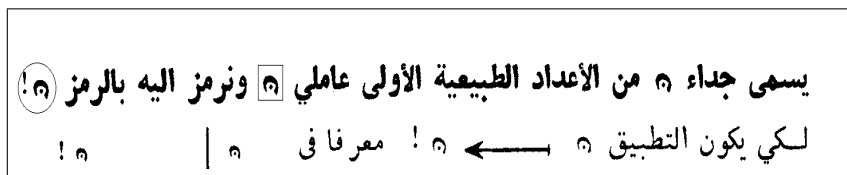


Figure 10: Factorial symbol in Handbook [3.12]

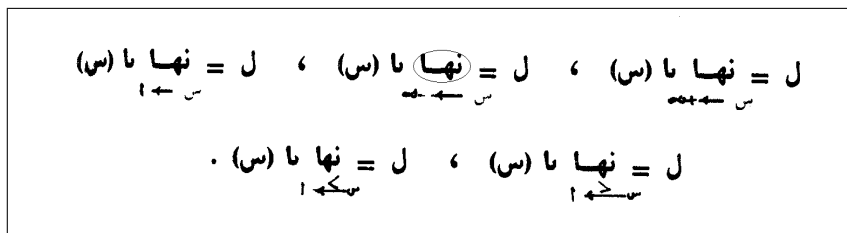


Figure 11: Conventional limit symbol in Handbook [3.12]

الرموز المستعملة في الهندسة :

يُرد في الهندسة النظرية عبارات يتكرر استخدامها كثيرا لذلك يستعاض عنها برموز خاصة سنورد أهمها فيما يلي :

الرمز	مدلوله	الرمز	مدلوله
∠	زاوية قائمة	قا	زاوية قائمة
△	مثلث	نق	نصف قطر دائرة
△△	مثلثان	∴	اذن
⊥	عمود على	∴	بما أن
//	يوازي	<	أكبر من
≠	لا يساوي	>	أصغر من
⌒	قوس		

Figure 16: Some symbols in Handbook [3.2]

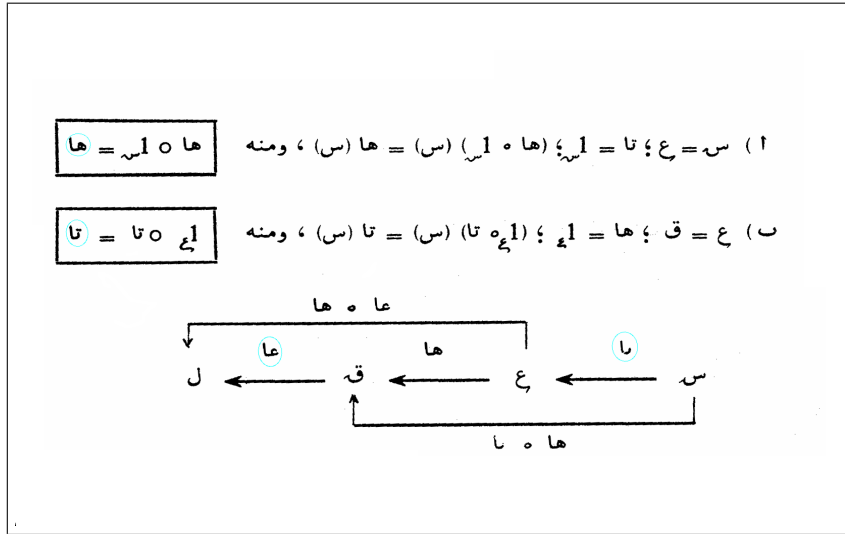


Figure 17: Stretched symbols in Handbook [3.12]

(٦) إذا علمت أن طول المستقيم AB المرسوم هنا هو 6 سنتيمترات فقدر أطوال AC و BC و OC و OC بمجرد النظر ثم قسها وقارن بين أطوالها والأطوال المقدرة.

(٧) إذا علمت أن $\angle A = 30^\circ$ وهي المرسومة أمامك في الشكل فاذكر قيم الزوايا الأخرى بمجرد النظر ثم قسها بالمنقلة وقيد الناتج في جدول كالآتي:

اسم الزاوية	قيمتها بالدرجات بمجرد النظر	قيمتها بالقياس

(٨) قس الزاوية المتعكسة $\angle C$ و $\angle D$ الميمنة بالشكل.

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

27 - المقدار الجبري :

عندما ترتبط مجموعة 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 . فمثلاً :

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

عبارة عن مقادير جبرية . أي أن :

المقدار الجبري عبارة عن مجموعة من الأعداد - المعبر عن بعضها أو كلها بحروف - مرتبطة من بعضها بعملية أو أكثر .

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

$$ح = ط (س^2 - 2 ش)$$

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

فإنه يكون لكل منها قيمة تختلف عن الآخر .

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

Figure 19: Alphabetical symbols in Handbook [3.5]

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 كتابتها وقراءتها عن كتابة الاعداد الصحيحة والعشرية وقراءتها . مثال ذلك : ٧ هكل ٦ دكل ٣ ل ٥ سل ٥ ملل .

وتقرأ :
سبعمة وثلاثة وستين ليتراً
واربعة وخمسين من الف.

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

تكتب :

Figure 20: Liter 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 منها جزء قدره 14754 م² . أوجد النسبة بين مساحة الجزء الباقى والمساحة الأصلية .

(199) زاويتان قيمتهما 30° و 25° ، جراد . فما نسبة الثانية إلى الأولى ؟

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

(201) مخروط وأسطوانة متساويان في شعاع (نصف قطر) القاعدة والارتفاع . أوجد النسبة بين حجم المخروط (ح) وحجم الأسطوانة (ح') .

Figure 21: Length unites symbols in Handbook [3.6]

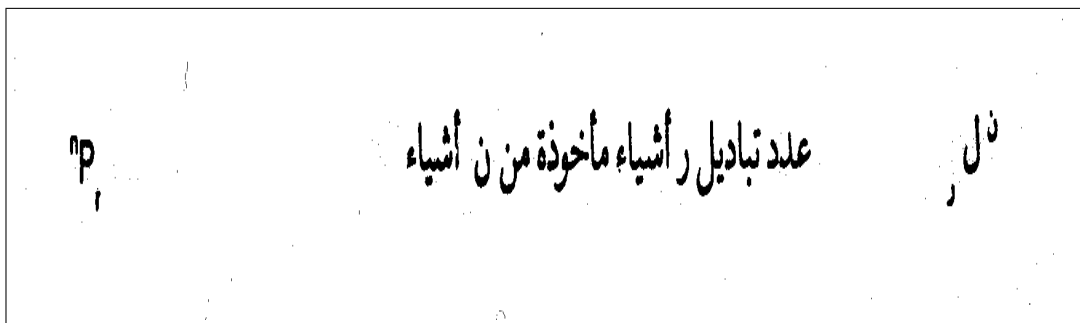


Figure 22: Arrangement symbol in Amman Convention [1.1]

(١) التبديل : هو ترتيب لعدة أشياء مختلفة بأخذها كلها أو بعضها في كل مرة.

(٢) الرمز P_r^n ، ويقرأ لام r ، يدل على عدد تباديل n من الأشياء المختلفة مأخوذ منها r من الأشياء في كل مرة حيث $r \geq 0$ أي أن :

$P_r^n =$ عدد الترتيبات (أو الأوضاع المختلفة) التي يمكن تكوينها من n من الأشياء بحيث يحتوى كل ترتيب على r من هذه الأشياء .

Figure 23: Arrangement symbol in Handbook

يرمز لهذا الناتج عادة بالرمز $n!$ ، ويقرأ مضروب n ، أي أن :

$n! = 1 \times 2 \times 3 \times \dots \times n$

Figure 24: Factorial symbol in Handbook