Arabic Inline Characters

for Qur’ānic and Classic orthography
in Unicode and computer typography

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DECO type

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Arabic Inline Characters

Unicode Arabic lacks the concept of contextually neutral, “inline” characters. Unicode’s Arabic functionality is limited as the result of a constraint in the contextual definition of character behaviour introduced for typewriters. It was subsequently ported to phototypesetters and inherited by computer typography, because it is derived from these systems. Software and fonts based on the present standard cannot handle inline letters, i.e., letters that are written not over but between letters, irrespective of their joining behaviour. As a result, classic Arabic orthography and Contemporary Qur’ān Orthography cannot be rendered with the present Unicode specifications for typographic behaviour.

The characters concerned are (with Qur’ānic examples whenever available):

1 This treatise focuses on the 1924 spelling of the Qurʾān Codex, also known as the King Fu’ad Qurʾān. Its spelling prevails all over the Arabic world; it is referred to here as Contemporary Qur’ānic Orthography.
1. INLINE HAMZA
U+0621 Arabic Letter Hamza
(wrong: U+0654 Hamza Above placed over U+0640 Tatweel)

<table>
<thead>
<tr>
<th></th>
<th>final</th>
<th>middle</th>
<th>initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>joined</td>
<td>non-joined</td>
<td>joined</td>
<td>non-joined</td>
</tr>
</tbody>
</table>

TMA
GR A Q 043:015
A SBGR B Q 006:139
A SR BL Q 002:211
A LA BB Q 007:032
A BB Q 002:099

2. INLINE ALIF
U+0670 Arabic Letter Superscript Alef
(provided it is preceded by U+064E Arabic Fatha)

<table>
<thead>
<tr>
<th></th>
<th>final</th>
<th>middle</th>
<th>initial</th>
</tr>
</thead>
<tbody>
<tr>
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<td>non-joined</td>
<td>joined</td>
<td>non-joined</td>
</tr>
</tbody>
</table>

GTY
Q 011:005
A EBD Y Q 002:178
A LTLMBN Q 002:193
SW BKM Q 007:026

3. INLINE YEH
U+06E6 Arabic Small Yeh
(identical with: U+06E7 Arabic Small High Yeh)

<table>
<thead>
<tr>
<th></th>
<th>final</th>
<th>middle</th>
<th>initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>joined</td>
<td>non-joined</td>
<td>joined</td>
<td>non-joined</td>
</tr>
</tbody>
</table>

A SMBH
Q 007:180
HD H Q 004:078
A BR HM Q 002:124
A LEHM Q 106:002

4. INLINE WAW
U+06E5 Arabic Small Waw
(redundant: U+083F Arabic Small High Waw)

<table>
<thead>
<tr>
<th></th>
<th>final</th>
<th>middle</th>
<th>initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>joined</td>
<td>non-joined</td>
<td>joined</td>
<td>non-joined</td>
</tr>
</tbody>
</table>

A BBH
Q 041:044
A W LBA H Q 008:034
LBSW A Q 017:007
WR Y Q 007:020

5. INLINE NOON
U+06E8 Arabic Small High Noon

<table>
<thead>
<tr>
<th></th>
<th>final</th>
<th>middle</th>
<th>initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>joined</td>
<td>non-joined</td>
<td>joined</td>
<td>non-joined</td>
</tr>
</tbody>
</table>

BGY
Q 021:088
All these letters can be represented as single, inline grapheme each. The additional encoded characters associated with some of them are redundant, at best positional variants. But they are misdefined when they are described as “superscript”: they should never be placed above the preceding character, but off-set to the left of it. U+0654 Hamza Above is not part of this system: it is a regular superscript character to be used as diacritic in combination with a base letter. The practice of using U+0654 Hamza Above placed over U+0640 Tatweel is untenable: with the improved accuracy of Arabic typesetting, the rules of elongation prevent the placing of elongation at random as carriers for off-set superscript characters.

A close-up of Hamza

For instance, Unicode defines the contextual behaviour of 0621 ARABIC LETTER HAMZA as “non-joining.” This unintentionally describes the behaviour of inline Hamza correctly - only when it is positioned between two non-joining letters:

\[
\text{badʾa-n} \ [\text{BD A}]
\]

However, totally analogous words where the letters surround the “inline Hamza” break up as a result of this definition:

\[
\text{šayʾa-n} \ [\text{SBA}]
\]

Inline Hamza in initial position appears to be unproblematic:

\[
\text{āyā} \ [\text{A BH}]
\]

This spelling with initial inline Hamza is a feature of modern Qurʾān orthography. Normal spelling never uses inline Hamza in initial position. Instead the alif-maddā combination is used:

\[
\text{āyā} \ [\text{A BH}]
\]

The problem with initial inline Hamza becomes visible when a letter is prefixed:

\[
\text{la āyā} \ [\text{LA BH}]
\]

This spelling is not known in the industry, and presently there is no solution for it. The popularly expected spelling is with lam alif-maddā:\n
\[
\text{la āyā} \ [\text{LA BH}]
\]

This defect cannot not be corrected by generically changing the contextual behaviour

3 Even that spelling can cause problems with fonts that have limited support for lam alif
of the Unicode 0621 ARABIC LETTER HAMZA, because the Arabic Block in Unicode is shared by all Arabic-scripted languages, some of which depend on non-joining Hamza. For instance in Persian there is a secondary, non-Arabic character that is indeed non-joining. Therefore it might even be necessary to introduce a new character ARABIC LETTER INLINE HAMZA in order to safeguard Classical Arabic Orthography and Contemporary Qur’ân Orthography in Unicode. An elegant alternative would be a language-dependent switch to change non-joining Hamza into inline Hamza in an Arabic context. This switch would not need to distinguish between Qur’ânic and modern Arabic: within Arabic there is no conflict.
Background

In the evolution of Arabic orthography, the *Hamza* was absent from the original Qur’ān text. It was a later addition, which is still reflected in the fact that it is absent in conventional presentations of the alphabet: schoolbooks, grammars and encyclopedias list only 28 letters.

Treatment of *Hamza*, originally a miniature head of ‘ayn, is analogous to and very likely based on that of the first generation vowel markers. The first generation vowel markers consist of a round shape, usually red, positioned above, below or inline the main script, i.e., between letters irrespective of their joining behaviour. The round shape is a single, generic vowel marker whose value is expressed by its position: a above the line (Fatha), i below the line (Kasra) and u (Dhamma) inline or on top of the line. In short: one shape, three positions.

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skeleton text

inline dhamma/dhammatan

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Q016:106: ٍّبٍّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّم‌ٍّمُّm. This is a fine illustration of the inline red dot for Dhamma (u) following first Meem (somewhat vague on top of the black main text), the superscript red dot above the second Meem for Fatha (a), the subscript red dot below dotless Beh (or unmarked Yeh) for Kasra (i) and the inline double dots for Dhammatan (u-n). The red dot above Tah is a subscript Kasra from the previous line; the Hamza is absent in the old manuscript. From: DAM 15.15.2, Dar Al Makhtutaat, Sanaa.

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4 Second generation, modern vowel markers Fatha, kasrä (with identical shape) and dammā (with distinct shape) are positioned above and below the main script or rasm (two shapes, two positions).
Modern *Hamza* still follows this same archaic pattern of one shape with three positions: it occurs above, below or *within* (between disjoining and just above joining letters of) the main script: one shape, three positions. The instances above and below the *rasm* are today encoded as digraphs consisting of a full letter, the so-called chairs، (alif, yā’, wāw) with the *Hamza* above or below it: أ، یٔ، ؤ.

Though instances where *Hamza* is positioned inline were covered correctly by metal typesetting, typewriters and phototypesetting failed to handle them at all, which in turn lead to defective computer support for Arabic. As a result, Classical Arabic and Contemporary Qur’anic Orthography cannot be handled on any computing platform.

**Examples taken from authoritative Arabic grammars and manuals:**

(c) If the hamzah is preceded by a long vowel and bears — , it has no chair (e.g. مُؤَوَّةٌ سَامِلْ). If, however, the hamzah is preceded by a long vowel and bears — or —, the chair usually corresponds to the vowel the hamzah bears (e.g. سَامِلْ سَامِلْ).

Out of necessity, modern computer spellings add an extra Yeh as “chair” for Hamza to the last word: هتُتٔطِظِ. Instead of هتُتٔطِظِ.

Elaborating a spelling detail, Farhat J. Ziadeh and R. Bayly Winder explain that inline Hamza is surrounded by joining letters: ءشِ. W. Fischer describes that after word-final syllable that ends in a long vowel or a consonant, Hamza is written without a “chair”. For all clarity regarding the consequences for joining, Fischer shows the nominal case of لِٔطِظِ as well as the adverbial case: لِٔطِظِ.

W. Fischer describes that in the classic orthography word-internally, after a consonant or after a long syllable, Hamza is written without a “chair”. Fischer illustrates this rule with non-joining سَامِلْ and with joining examples: سَامِلْ. 
W. Fischer describes that non-initial sequences of ʿī and ʿū are nowadays written یُ (NB: Yeh without dots) and ۆ. However older orthography avoids repetitions of ی and ۆ: ی and ۆ. Hamza is written without a “chair”. A derived the pattern is applied rigorously and without exception in the 1924 Cairo edition of the Qurʾān. A Hamza is written inline whenever it is followed or preceeded by a long vowel, regardless of the spelling of that long vowel. This leads to an exceptionally high frequency of Arabic letters inline Hamza - for which the present combination of computer typography and Unicode specifications offer no solution.

Wright observes that the adverbial case of یُ and ۆ, correctly written as یُ and ۆ, are frequently written as یُ and ۆ. Today یُ is written یُ.
Inline characters in the manuscript tradition

The contextual behaviour of inline Hamza in the manuscript tradition is regular and straightforward: it is always placed between the preceding and following letter, where necessary over the middle of the connection⁴ – even if the line is very short⁴. The examples below illustrate final and non-final inline Hamza between connected letters.

When reproducing the computerized graphemic content of the 1924 Cairo edition with computer-synthesized naskh script, a small number of unexpected results were encountered. Certain spellings typeset with the dedicated typeface – designed especially for this Qurʾān – warrant a comparison with other codices.

1. اَلْالْأَن

In Q4:18 of the Cairo edition, the word l-āna is spelled with a cluster of four superscript graphemic attachments, <sukūn> <inline hamzā> <fathā> <inline alif>.

This cluster is the result of the spelling rule, characteristic of the Cairo edition, that glottal stop is written with inline hamzā when it is followed by long vowel.

Every grapheme of this word is present in Unicode, but the industrial does not design Arabic fonts to handle such character sequences.

The rules of naskh, the style of choice for rendering the Qurʾān, do not allow elongation of Lam⁵, and as a result computer-generated naskh produces a correctly shaped text skeleton with an ugly stack of attachments.

Where the mechanized writing of the 1924 Cairo edition uses a spacious skeleton base لـ, the calligraphic constraints of naskh allow only a very tight connection لـ that cannot accommodate the total of six superscript attachments of the second Letter Block⁶. Unlike the Cairo typography, in naskh calligraphy no elongation between initial <lām> and final <nūn> can be attested⁷.

Ottoman codices, use a different spelling for the word l-āna, that does not conflict with calligraphic patterns⁸.
The supplement of the 1924 edition contains a section about the use of miniature letters: they are inserted where “essential letters were missing in the ʿUṯmānī codices”. It gives a number of examples, one of which happened to show irregular results when printed with computer-generated, regular naskh:

2. \textit{wly}

The word \textit{walīyīya} “my protector” (Q7:196) consists of the elements \textit{waliy} “protector” and the suffix \textit{–īya}10 “my”. The skeleton consists of three letters: \textit{<WLY>}. In miniature, a missing <super-script \textit{yā’}> is added including its own reduplication mark, \textit{šaddā}, and its own subscript vowel \textit{i}, \textit{kasrā}: \textit{walī}-\textit{iya}.

Every grapheme of this word is present in Unicode, there is even a code for elongation.

From such same text code, computer-generated, regular naskh—which cannot execute illegal elongation11– sähpes a Letter Block \textit{<LY>} لى that is too tight to accommodate the total of three superscript and two subscript attachments. By contrast, the 1924 Cairo edition is typeset with a stretched skeleton base لى that breaks traditional script rules, but in this manner provides the necessary room.

When comparing the same passage in other codices, variant spellings of such problematic words are encountered. These illustrate the different ways that calligraphers have solved the same problem.

The 19\textsuperscript{th} century masterpiece of Ottoman Calligraphy by Elhaç Haфиз Mehmed Emin Rüşdi Efendi\textsuperscript{12} adds a second letter \textit{yā’} to the main letter group: \textit{<WLYY>}. In Nash, the curve preceding final \textit{yā’} is a distinct letter: it represents the penultimate form of medial \textit{yā’}. 

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{example.png}
\caption{Example of a calligraphic letter}
\end{figure}
A recent Turkish Qurʾān in the Ottoman tradition\textsuperscript{13} adds the correction to \textless WLY\textgreater in an unusual and subtle manner by placing a double point under the – swashed – final \textit{yāʾ}. Please note that \textit{yāʾ} never gets dots in final position, therefore the dots are a clear hint at the missing \textit{yāʾ} in middle position). Moreover, there are vowels for four consonants, but the skeleton contains only three: \textless WLY\textgreater.

An Indian Qurʾān\textsuperscript{14} solves this calligraphic conundrum elegantly within the calligraphic constraints. It should be noted that it adds the missing \textit{yāʾ} in superscript final position instead of in the middle of the letter group.

A recent North African edition\textsuperscript{15} also writes the missing \textit{yāʾ} into the main text skeleton: \textless WLYY\textgreater. The resulting spelling does not conflict with calligraphic rules. Typical for North African writing, the extra inverted curve preceding final \textit{yāʾ} is part of the same final \textit{yāʾ}.

NB. What makes this case interesting is that in terms of Arabic morpho-phonology, there is no letter missing at all. The elements \textit{waliy} “protector” and the suffix –\textit{i(ya)/yang “my” contract into waliya, eliding one \textit{yāʾ}}. The result is the text skeleton \textless WLY\textgreater, as seen in practically all quoted words. The annotational marks that superimpose the form \textit{waliy-i-ya} with an extra syllable \textless WLYY\textgreater cause problems with the computer-generated \textit{naskh}. This in turn lead to the discovery of variant spellings in other codices.
The 1924 Cairo edition is apparently based on a comparison with older manuscripts possibly to correct spelling deviations seen in Ottoman Turkish codices. In this case the editors decided to return to the base form <WLY>. Without annotation marks, this rasm can be interpreted as a grammatically correct Arabic word meaning “my protector”. It is intriguing why the editors inserted a complex correction (<miniature yā’> <šaddā> <kasrā> superimposing a grammatical form not recorded in standard grammars that is difficult to handle within the observed constraints of Persian and Ottoman calligraphy. One possible answer is that the skeleton text <WLY> reflects a version of the word, possibly waliya, that differs from the oral tradition which apparently has it as waliyiyā.

3. alī

The word l-lā’ī (Q33:4) also contains a Letter Block <LY> that is even longer than the previous one. The long ā is not part of the rasm, instead it is written by a Fatha on the lām followed by an inline alif – which in turn is marked with a cautionary maddā preceding the Hamza. Since this Hamza is followed by a long vowel, in the Cairo spelling it must remain without a chair, i.e., inline, producing a sequence of two inline letters between two letters that calligraphy cannot stretched to accommodate. Again, all graphemes and supporting elongations of this word can be stored in the Unicode format, but no font can render them coherently.

As before, naskh script grammar does allow for stretched lam, as they have not been attested in the calligraphic corpus. As a result, again an unusual stack of attachments is printed by the naskh computer model.

Rüşdi Efendi, whose work belongs to the corpus used for the model, uses a different spelling for long ā: a superscript miniature alif followed by an alif in the rasm.
The recent Turkish codex in Ottoman tradition by Hamîd el-Âmidî has the same *rasm* as the Cairo edition, a single superscript miniature *alif* for à and, typical for Ottoman orthography, subscript *alif* for long î. Note the inverted order of miniature *alif* – cautionary *maddâ*. No *waślâ* is written on the initial *alif*.

The Indian edition uses essentially the same spelling as Hamîd el-Âmidî. Note that a *sukûn* is written over the consonantal element of the final long î.

4. **a sbgr b**

The word *sta’jarta* (Q28:26) contains a glottal stop, written with *Hamza* without chair, typeset over an extra connection line.

All graphemes and the extra connection line of this word can be stored in Unicode format, but no font can render them coherently.

*Naskh* rules preclude the extra connection line, and such elongated connections directly preceding letters of the *ǧīm* class cannot be attested in Ottoman *naskh*. As a result, the inline *Hamza* with its own *sukûn* creates an unusual cluster of superscript marks in computer-generated *naskh*.

Rüşdi Efendi follows a different spelling that circumnavigates the problem of the clustering superscript marks: he writes the glottal stop with an *alif* (historically the original function of *alif*, before *Hamza* was introduced); the *sukûn* is rounded.

Hamîd el-Âmidî uses the exact same spelling as Rüşdi Efendi, but *waślâ* is omitted.

The Indian edition uses the same spelling as Hamîd el-Âmidî. Note that the *sukûn* has approximately the same shape as in the Cairo edition.
The North African edition has a rasm similar to the one in the Cairo edition, but it writes the glottal stop as an inline alif. The – rounded – sukūn is omitted from the miniature alif.

notes

1. This treatise focuses on the 1924 spelling of the Qurʾān Codex, also known as the King Fuʿad Qurʾān. Its spelling prevails all over the Arabic world; it is referred to here as Contemporary Qurʾānic Orthography.


3. This rules out the use of Unicode 0654 Arabic Hamza Above because that character is designed to combine with the preceding letter.

4. On the typographic or calligraphic level, the connecting line is often lengthened to create more room for the inline Hamza. However, the lengthening of a connecting line, or keshideh, is subject to calligraphic constraints that are taken into consideration by sophisticated typography. Moreover, some calligraphic styles (notably Ruqʿā) and the typography emulating them do not elongate connecting lines. This fact rules out standardizing the use of Unicode 0654 Arabic Hamza Above over the connecting element 0640 Arabic Tatweel.

5. In building this computer synthesis of traditional naskh, care was taken only to implement morphographic rules that were attested in manuscripts from a selected corpus of naskh calligraphy in the style of the Ottoman school.

6. Letter Block: in calligraphy, this is the smallest unit of writing. It consists of a single letter or an uninterrupted group of connected letters. The morphographic rules of calligraphy determine the appropriate shape of a syntagm.

7. Only in one instance (Q10:51), Rusdi Efendi makes an exception to this apparent rule, to accommodate for the same spelling: ُ، corresponding to Egyptian ١٠.

8. al-Qurʾān al-Karīm, handwritten by the calligrapher al-Hāǧǧ Ḥāfiẓ Muḥammad Amin Rušdī Afandi, 1218/1803, reprint 1370/1951, Baghdad. This was one of the Ottoman codices analysed in order to design the DecoType ace naskh simulator.


11. Irregular elongation is suppressed by DecoType ace’s Trashide® technology.


17. This sample is again Q36: 1-12 using the spelling of al-Muṣḥaf aš-Ṣarif, Būlāq 1342/1924 (the “Cairo Qurʾān”).
SUPPLEMENT

The supplement lists a selection of actual Qur’ānic examples that cannot be printed without support for Arabic inline characters. The purpose is to handle these cases without breaking the overall integrity of classic Arabic script structure. The “adjusted” shapes are the planned result. With the present structures resulting from regular Unicode, printed in red, the exceptions cannot yet be rendered. Please note that the sequence Fatha-superscript alif requires the superscript alif to be handled like an inline character.

NB - the examples are given in the the style of the metal typeface of the 1924 Cairo Qur’ān.
هذا
شَعِيرٌ
شُفِعَ
الْمُذَّبَن
الضَّعِفَ
أَصِبْحِمَ
أَصْبِحْنِهِ
بِئِتٍ
قَنْتَ
الأَمَنتِ
يُسْلِيَ
 للأَهَنَّ
بَوَأ
تَرَى
تَرَبَا
صَر
سَوَءَةً

إِسْرَعْيلَ
بُوَأ
تَرَى
تَرَبَا
صَر
سَوَءَةً

كَلَ
بَر
دَّ
شَر
الِهِنَّ
إِسْرَعْيلَ
صَرَطَ طَيْرَ آَلَّاَلْمُوٰنَ تَتَنَكَّرُ شَرْكَوْا أَنَاَ الحَاكِمُ مَلِكَةَ أَكْرَهْهُمَا أَكْلُوْا
أَكْنَا
وَلَكِن
نَكَلَا
لِفْ
لِهْ
حَلْمٌ
الْقَلْبِ
أَغْلَالَا
قِيْمًا
الْبَيْنِ
الْغَلْبِ
الْعَلْبَاءَ
ناسِمْهُ
أَصِنِمَكُ
أَفْتَمِرْنِهُ
يَبِّي
مِمْر
أَصِبْب
إِصْلَحَا
سَحْحَتْ
سَكْر
تَنْجَوْا
يَبِّي
بَجَد
َجَبَتْ
فَحَمِلَتْ
الْحَفِظُتِ
لَسْج
لَصَلِحْتِ
سَمُو
شَيْخُتِ
إِبْرَاهِيمَ
إِلَفْهُمْ
ءَاثَانَ
الْمَوْعِرَةُ