enumext

ENUMERATE EXERCISE SHEETS

v2.6 2026-11-24*

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CTAN: https://www.ctan.org/pkg/enumext

https://github.com/pablgonz/enumext

Abstract

This package provides enumerated list environments compatible with *tagging* PDF for creating *"simple exercise sheets"* along with *"multiple choice questions"*, storing the *"answers"* to these in memory using `multicol` package.

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Motivation and acknowledgments

Usually, it is enough to use the classic `enumerate` environment to generate *"simple exercise sheets"* or *"multiple choice questions"*, the basic idea behind enumext is to cover three points:

1. To have a simple interface to be able to write *"lists of exercises"* with *"answers"*.
2. To have a simple interface for writing *"multiple choice questions"*.
3. To have a simple interface for placing *"columns"* and *"drawings"* or *"tables"*.

This package would not be possible without Phelype Oleinik who has collaborated and adapted a large part of the code and all LaTeX team for their great work and to the different members of the TeX-SX community who have provided great answers and ideas. Here are notes on the main ones:

1. Answer given by Alan Munn in \topsep, \itemsep, \partopsep, \parsep - what do they each mean (and what about the bottom)?

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2. Answer given by Enrico Gregorio in Understanding minipages - aligning at top
3. Answer given by Ulrich Diez in Different mechanics of hyperlink vs. hyperref
4. Answer given by Enrico Gregorio in Minipage and multicols, vertical alignment

License and Requirements

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The enumext package loads and requires multicol[1] package, need to have a modern TEX distribution such as TEX Live or MiKTEX. It has been tested with the standard classes provided by LATEX: book, report, article and letter on 10pt, 11pt and 12pt.

The minimum requirement is LATEX release 2026-11-01.

1 Introduction

In the LATEX world there are many useful packages and classes for creating *"lists of exercises"*, *"worksheets"* or *"multiple choice questions"*, classes like exam[2] and packages like xsim[3] do the job perfectly, but they don't always fit the basic day to day needs.

In the work of many teachers it is common to use *"simple exercise sheets"* also known as *"informal lists of exercises"*, for example:

1. Factor $x^2 - 2x + 1$
2. Factor $3x + 3y + 3z$
3. True False
   (a) $\alpha > \delta$
   (b) LATEX2e is cool?
4. Related to Linux
   (a) You use Linux?
   (b) Usually uses the package manager?
   (c) Rate the following package and class
      i. `xsim-exam`
      ii. `xsim`
      iii. `exsheets`

Sometimes it is also useful to show the *"answers"* along with the questions:

1. Factor $x^2 - 2x + 1$
   * $(x-1)^2$
2. Factor $3x + 3y + 3z$
   * $3(x+y+z)$
3. True False
   (a) $\alpha > \delta$
      * False
   (b) LATEX2e is cool?
      * Very True!
4. Related to Linux
   (a) You use Linux?
      * Yes
   (b) Usually uses the package manager?
      * Yes, `dnf`
   (c) Rate the following package and class
      i. `xsim-exam`
         * doesn't exist for now :(
      ii. `xsim`
         * very good
      iii. `exsheets`
         * obsolete

Or to refer to a specific question and its *"answer"*, for example:

The answer to 3.(b) is "Very True!" and the answer to 4.(c).ii is "very good".

Or to print all the *"answers"*:

1. $(x-1)^2$ ※
2. $3(x+y+z)$ ※
3. (a) False ※
   (b) Very True! ※
4. (a) Yes ※
   (b) Yes, `dnf` ※
   (c) i. doesn't exist for now :(※
      ii. very good ※
      iii. obsolete ※

Another very common thing to use is *"multiple choice questions"*, for example:

1. First type of questions

   A) value
   B) correct
   C) value
   D) value

2. Second type of questions

   I. $2\alpha + 2\delta = 90^\circ$
   II. $\alpha = \delta$
   III. $\angle EDF = 45^\circ$

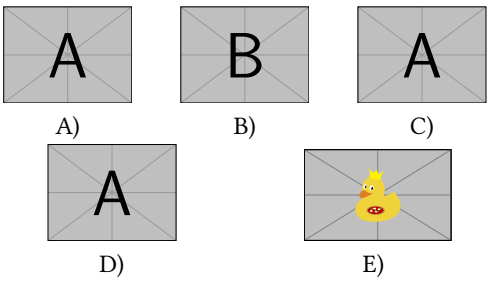
   A) I only
   B) II only
   C) I and II only
   D) I and III only
   E) I, II, and III

⋆ 3. Third type of questions

   (1) $2\alpha + 2\delta = 90^\circ$
   (2) $\angle EDF = 45^\circ$

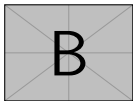
   A) value
   B) value
   C) value
   D) value
   E) value

4. Question with image and label below:



5. Question with image on right side:

   A) value
   B) value
   C) value
   D) correct
   E) value



Here the ⟨*label*⟩ and a *"short note"* left as an explanation are stored, and then printed:

1. B) $x = 5$ ※
2. D) ※
3. C) some note ※
4. E) A duck ※
5. D) "other note" ※

The enumext package was created and designed to meet these small requirements in the creation of *"simple worksheets"* and *"multiple choice questions"*.

These *"simple worksheets"* or *"multiple choice questions"* appear to be easy to obtain using a combination of the `enumerate`, `minipage` and `multicols` environments, but like many things, what *"looks simple"* is not so simple.

1.1 Description and usage

The enumext package defines enumerated environments using the `list` environment provided by LaTeX[4], but *"does not redefine"* any internal commands associated with it such as `\list`, `\endlist` or `\item` outside of the *"scope"* in which they are defined.

This package is NOT intended to replace the `enumerate` environment nor replace the powerful `enumitem`[5], the approach is intended to work without hindering either of them.

This package can be used with `xelatex`, `lualatex`, `pdflatex` and the classical `latex»dvips»ps2pdf` and is present in TeX Live and MiKTeX, use the package manager to install. For manual installation, download enumext.zip and unzip it, run `luatex enumext.ins` and move all files to appropriate locations, then run `mktexlsr`. To produce the documentation run `arara enumext.dtx`.

```
enumext.sty  »  TDS:tex/latex/enumext/
enumext.pdf  »  TDS:doc/latex/enumext/
README.md    »  TDS:doc/latex/enumext/
enumext.dtx  »  TDS:source/latex/enumext/
enumext.ins  »  TDS:source/latex/enumext/
```

The package is loaded in the usual way:

```
\usepackage{enumext}
```

1.2 The concept of left margin

There is a direct relationship between the parameters `\leftmargin`, `\itemindent`, `\labelwidth` and `\labelsep` plus an *"extra space"*, which makes it difficult to obtain the desired *horizontal spaces* in a `list` environment. Usually the `list` should not go beyond the left margin of the page, but since these four values are related, that causes a problem.

The `enumitem`[5] package adds the `\labelindent` parameter to solve some of these problems. A simplified representation of this in the figure 1.

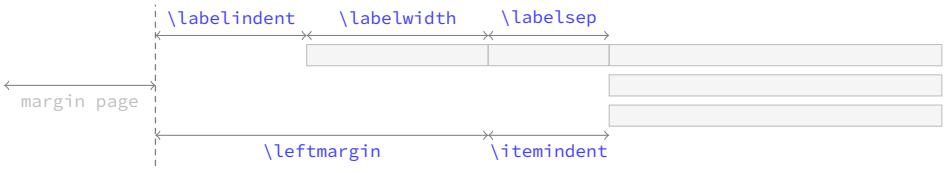


Figure 1: Representation of horizontal lengths in `enumitem`.

The enumext package does NOT provide a user interface to set the values for `\leftmargin` and `\itemindent`, instead it provides the keys `list-offset` and `list-indent` which internally set the values for `\leftmargin` and `\itemindent`. The concepts of `\leftmargin` and `\itemindent` are different in enumext. The figure 2 shows the visual representation of idea.

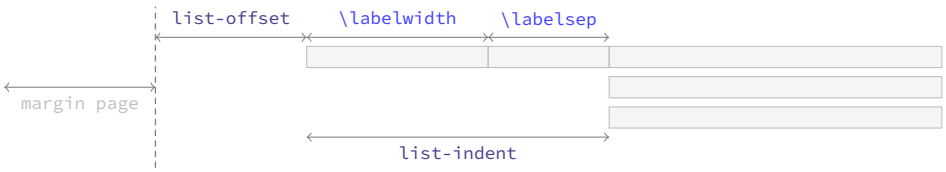


Figure 2: Representation of horizontal lengths concept in enumext.

In this way the number of parameters to pass is reduced a *little*. With the default values of keys `list-offset`, `list-indent`, `labelwidth` and `labelsep` the lists will have the (usually) expected output for *"simple worksheets"*. The figure 3 shows the visual representation.

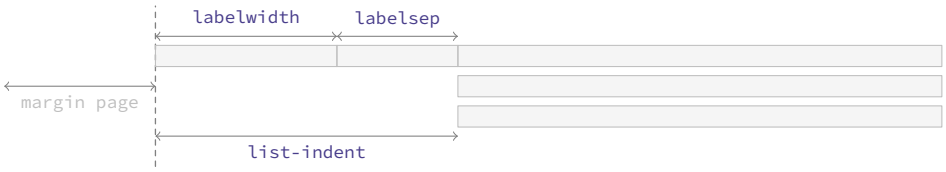


Figure 3: Default horizontal lengths `list-offset=0pt`, `list-indent=\labelwidth+\labelsep` in enumext.

1.3 User interface

The user interface consists of two main list environments `enumext` (vertical) and `enumext*` (horizontal), the environment `anskey*` and the command `\anskey` to *"store content"* and the environments `keyans`, `keyans*` and `keyanspic` for multiple choice. It also provides the commands `\getkeyans` to print individual *stored content*, `\printkeyans` to print all *stored content*, `\foreachkeyans` to print a range of *stored content*, `\miniright` for `minipage`, `\setenumext` to config [⟨*key* = *val*⟩], `\setenumextmeta` to add a *"meta-key"* and `\resetenumext` to reset counters.

1.3.1 Public counters

The package enumext uses the `enumXi`, `enumXii`, `enumXiii`, `enumXiv` counters for the *four* nesting levels of the `enumext` environment, the `enumXv` counter for the `keyans` environment, the `enumXvi` counter for the `keyanspic` environment, the counter `enumXvii` for `enumext*` environment and the counter `enumXviii` for `keyans*` environment.

If any package defines these *counters* or they are user-defined in the document, the package will return a *"fatal error"* and abort the load.

1.3.2 Public dimension

The package enumext only provides a *single public dimension* `\itemwidth` and is intended for user convenience only and is NOT for internal use as such. The dimension `\itemwidth` is a *rigid length* and contains the *"width of the content"* of each `\item` regardless of `labelwidth` and `labelsep`.

If any package defines `\itemwidth` or the user defines `\itemwidth` in the document, the package will overwrite it without warning.

1.3.3 Support for multicol

The package provides direct support for using the `multicol`[1] package. This allows for a two-column output as shown in the figure 4.

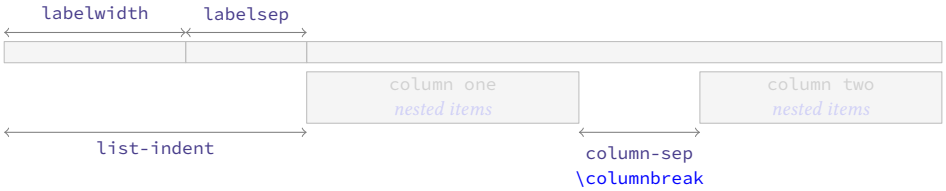


Figure 4: Representation of the two column output for a nested level in `enumext` environment.

The *"non starred"* version of the `multicols` environment is always used together with the `\raggedcolumns` command and is controlled by `columns` and `columns-sep` keys. It can be used in all nesting levels of the environment `enumext` and the environment `keyans` and can together with the `mini-env` key. If you need to force a start a new column `\columnbreak` must be used (§5.7).

The `\columnseprule` command is not available as a key and is set to *"zero"* for the inner levels and the `keyans` environment. If the value of this is set inside the document, it will affect *"all environments"* that use the `columns` key.

1.3.4 Support for `minipage`

The package provides direct support for `minipage` environment, this allows you to obtain an output like the one shown in figure 5.

The `minipage` environments on the *"left side"* and *"right side"* are always used with *"aligned on top"* `[t]`. It can be used in all nesting levels of the environment `enumext` and the environment `keyans` and is controlled by `mini-env` and `mini-sep` keys. In order to switch from the *"left"* side `minipage` environment to the *"right"* side one must use the command `\miniright` (§5.8).



Figure 5: Representation of the `mini-env` output for a nested level `enumext` environment.

1.3.5 The `\label` and `\ref` system

This package provides a user interface like the `enumitem`[5] package to customize the references which is activated by the `ref` key (§5.1), the standard LaTeX `\label` and `\ref` commands work as usual. It also provides an *"internal reference"* system for the *"stored content"* by means of the key `save-ref` (§6.1.1) when the key `save-ans` is active (§6.1).

1.3.6 Support for `\footnote`

The `enumext*` and `keyans*` environments and the `mini-env` key use the `minipage` environment in their implementation but in a transparent way for the user, it is only used for typesetting. The implementation supports `\footnote` and is compatible with `hyperref` and works the same way as if used anywhere in the document.

Unfortunately, if `hyperref` is loaded and *tagged* PDF is not active, it will not produce the "links", the internal implementation uses `\footnotetext`[⟨*number*⟩] and `\footnotemark`[⟨*number*⟩]{⟨*text*⟩} and "links" for this are not supported by the `hyperref` package.

The best way to solve this is to use Jean-François Burnol's `footnotehyper`[6] package. It will support keeping the "links" if `hyperref` is loaded with the `hyperfootnotes=true` option (default). Version 2.0 (2026/11/12) also supports *tagged* PDF. Load it as follows:

```
\usepackage{footnotehyper}
\makesavenoteenv{enumext}
\makesavenoteenv{enumext*}
```

With *tagged* PDF active and `footnotehyper` v2.0 or later loaded, the package enumext uses it for the notes. If `footnotehyper` is not loaded, or it is an older version that is not compatible with *tagged* PDF, the package redefines `\footnote` internally and the "links" are not produced; in `enumext*` and `keyans*` the notes are processed inside the item and printed after the environment, which avoids the kernel issue 1337 (a `\footnotetext` after a list gives a `tagpdf` error). With an older version, load `footnotehyper` only when *tagged* PDF is not active, using `\IfDocumentMetadataF`.

2 The environments provided

The package enumext provides two main list environments, the *vertical* environment `enumext` and the *horizontal* environment `enumext*`.

`enumext`
`enumext*`

```
\begin{enumext}[⟨keyval list⟩]
  \item ⟨item content⟩
  \item [⟨custom⟩] ⟨item content⟩
  \item*[⟨symbol⟩][⟨offset⟩] ⟨item content⟩
\end{enumext}
```

```
\begin{enumext*}[⟨keyval list⟩]
  \item ⟨item content⟩
  \item [⟨custom⟩] ⟨item content⟩
  \item*[⟨symbol⟩][⟨offset⟩] ⟨item content⟩
\end{enumext*}
```

2.1 The environment `enumext`

The `enumext` is an environment that works in the same way as the standard `enumerate` environment provided by LaTeX, `\item` and `\item`[⟨*custom*⟩] commands work in the usual way. The environment can be nested with at most *"four levels"* and the options can be configured globally using `\setenumext` command and locally using [⟨*key* = *val*⟩] in the environment.

Example with `columns=2`

1. This text is in the first level.
   (a) This text is in the second level.
      i. This text is in the third level.
A. This text is in the fourth level.
X This text is in the first level.
⋆ 2. This text is in the first level.

2.2 The environment `enumext*`

The `enumext*` is a *horizontal list environment* similar to the `shortenumerate` or `tasks` environments provided by the `shortlst`[7] and `tasks`[8] packages, `\item` and `\item`[⟨*custom*⟩] work as usual. The options can be configured globally using `\setenumext` command and locally using [⟨*key* = *val*⟩] in the environment.

Some considerations to take into account for this environment:

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- The environment cannot be nested within itself or in the environment keyans*, but it can be nested within enumext and vice versa.
- Each *"item content"* in the environment is placed within a minipage environment whose *width* is stored in the dimension \itemwidth does NOT include labelwidth and labelsep, only the *width of the content*. The only exception is an item that occupies the whole row when the key item-break is active (§2.4.1).
- You cannot have floating environments like figure or table or \marginpar but \footnote with hyperref is supported. If you want to activate the links you must load footnotehyper and hyperref packages (§1.3.6).
- The standard list environments itemize, enumerate, description, quote, quotation, verse and list, and the environments center, flushleft, flushright, trivlist, tabbing, verbatim and those created with \newtheorem can be used in the *"item content"*, also nested in themselves, because inside them \item is the standard command (§13.48.2).

Example with columns=2

1. This text is in the first level.
2. This text is in the first level.

X This text is in the first level.

⋆ 4. This text is in the first level.

2.3 The command \item*

\item* \item*[⟨*symbol*⟩][⟨*offset*⟩]

The \item*, \item*[⟨*symbol*⟩] and \item*[⟨*symbol*⟩][⟨*offset*⟩] work like the numbered \item, but places a ⟨*symbol*⟩ to the *"left"* of the ⟨*label*⟩ separated from it by the ⟨*offset*⟩ set by the *second optional argument*.

The *starred argument* '*' cannot be separated by spaces '␣' from the command, i.e. \item* and the *first optional argument* does NOT support *verbatim content*. It can be configured with the keys item-sym* and item-pos* locally in the environment or globally using \setenumext command (§3).

The behavior of \item* in the enumext and enumext* environments is NOT the same as in the keyans and keyans* environments.

2.3.1 Keys for \item*

item-sym* = {⟨*symbol*⟩} default: *textborn*

Sets the *symbol* to be displayed to the *"left"* of the box containing the current ⟨*label*⟩ set by labelwidth key for \item* in enumext and enumext*. The *symbol* can be in *text* or *math* mode, for example item-sym*={$\star$}.

item-pos* = {⟨*rigid length*⟩} default: *by levels*

Sets the *offset* between the box containing the current ⟨*label*⟩ defined by labelwidth key and the ⟨*symbol*⟩ set by item-sym* key. The default values are set by labelsep key at each level. If positive values are passed, it will *offset to the left*; if negative values are passed it will *offset to the right*.

2.4 The command \item in enumext*

\item \item(⟨*columns*⟩)

The \item command for the enumext* environment provides a *"first optional argument"* \item(⟨*columns*⟩) which *"joins items"* between columns.

Let's consider the following examples adapted directly from the tasks package:

```
\begin{enumext*}[widest=10,columns=4]
  \item The first
  \item* The second
  \item The third
  \item The fourth
  \item(3)* The fifth item is way too long for this and needs three columns
  \item The sixth
  \item The seventh
  \item(2)[X] The eighth item is way too long for this and needs two columns
    (\the\itemwidth)
  \item The ninth
  \item[Z] The tenth (\the\itemwidth)
\end{enumext*}
```

1. The first
⋆ 2. The second
3. The third
4. The fourth
⋆ 5. The fifth item is way too long for this and needs three columns
6. The sixth
7. The seventh
X The eighth item is way too long for this and needs two columns (196.17749pt)
9. The ninth

Z The tenth (89.28171pt)

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2.4.1 Items on the whole row: the item-break key

item-break = {⟨*true* | *false*⟩} default: *false*

By default the *"item content"* is typeset in a minipage, so an item cannot be broken between two pages: if it does not fit in the rest of the page it moves entirely to the next one. When this key is true and an item occupies the *whole row*, the content is typeset directly in the paragraph, without the minipage, and it can continue on the next page.

An item occupies the whole row when it is \item(⟨*columns*⟩) with ⟨*columns*⟩ equal to the value of the columns key and it is the first item of a row, or when columns=1, where every item occupies the whole row. If ⟨*columns*⟩ is greater than the columns left in the row it is reduced, as explained in the *warnings* for joined items, so the item does NOT occupy the whole row and remains in a minipage.

The ⟨*label*⟩ is placed as always in the box set by labelwidth and labelsep, and the following lines of the item are indented by the same amount. The keys listparindent and parsep apply to the paragraphs of the item. The other items of the environment are not modified. The key works in enumext* and keyans*, locally and with \setenumext (§3).

The vertical space around an item typeset without minipage can differ slightly from that of an item typeset in a box, because the item takes part in the paragraph and page breaking.

In the following example the third item occupies the whole row; if it were near the end of a page its text could continue on the next one:

```
\begin{enumext*}[columns=2,item-break=true]
  \item One
  \item Two
  \item(2) This item occupies the whole row and can be broken between pages.
  \item Four
\end{enumext*}
```

1. One
2. Two
3. This item occupies the whole row and can be broken between pages.
4. Four

3 The command \setenumext

\setenumext

\setenumext{⟨*key = val*⟩}
\setenumext[⟨*enumext, level*⟩]{⟨*key = val*⟩}
\setenumext[⟨*enumext**⟩]{⟨*key = val*⟩}
\setenumext[⟨*keyans*⟩]{⟨*key = val*⟩}
\setenumext[⟨*keyans**⟩]{⟨*key = val*⟩}
\setenumext[⟨*print, level*⟩]{⟨*key = val*⟩}
\setenumext[⟨*print, **⟩]{⟨*key = val*⟩}
\setenumext[⟨*print**⟩]{⟨*key = val*⟩}

The command \setenumext sets the ⟨*keys*⟩ on a global basis for environments enumext, enumext*, keyans, keyans* and the \printkeyans command. It can be used both in the preamble and in the body of the document as many times as desired.

The ⟨*keys*⟩ set in the *optional argument* of environments and commands have the *highest precedence*, overriding both options passed by \setenumext. If the *optional argument* is not passed, the *first level* of the environment enumext will be taken by default.

For security reasons the keys resume *"with value"*, resume*, reset, reset*, series and save-ans they can NOT be set by this command and are ignored. The key save-ans that activates the *"storage system"* must be passed directly in the *optional argument* of the *"first level"* of the environment in which they are executed.

4 The command \setenumextmeta

\setenumextmeta

\setenumextmeta[⟨1⟩]{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}
\setenumextmeta[⟨2⟩]{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}
\setenumextmeta[⟨3⟩]{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}
\setenumextmeta[⟨4⟩]{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}
\setenumextmeta[⟨*⟩]{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}
\setenumextmeta*{⟨*key name*⟩}{⟨*key-one = val, key-two = val, ...*⟩}

The command \setenumextmeta adds a new *"meta-key"* for the environments enumext and enumext*, the {⟨*key name*⟩} must be different from those defined by the package. The *optional argument* of the form [1], [2], [3], [4] adds a new *"meta-key"* for levels 1, 2, 3 and 4 of the enumext environment, the form [*] adds a new *"meta-key"* for the enumext* environment. If it is run *without* the *optional argument*, it will adds a new *"meta-key"* for the *"first level"* of the enumext environment.

The *starred argument* '*' will create the new *"meta-key"* for the environment enumext* and for *"all levels"* of the environment enumext. For example: \setenumextmeta*{midsep}{topsep=3pt, partopsep=0pt} will create a new key midsep available for all levels of the enumext environment and the enumext* environment and it can be used like any other key so \begin{enumext}[midsep] and \begin{enumext*}[midsep] will be valid.

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5 The keyval system

The ⟨*key = val*⟩ system used by the enumext package is implemented using l3keys so it must be noted that ⟨*keys*⟩ marked as *"value forbidden"*, that is ⟨*key*⟩ is different from ⟨*key=*⟩.

All ⟨*keys*⟩ described in this section are available for the enumext, enumext*, keyans and keyans* environments with the exception of the keys series, resume, resume*, reset and reset* which are only available for the enumext and enumext* environments; and the keys mini-right, mini-right* which are only available for the enumext* and keyans* environments.

All ⟨*keys*⟩ related to vertical or horizontal spacing accept a *"skip"* or *"dim"* expression if passed between braces, i.e. you do not need to use \dimeval or \dimexpr to perform calculations.

It should be kept in mind that using any ⟨*key*⟩ that sets *rubber lengths* or *rigid lengths* for vertical or horizontal space on a level will influence the vertical and horizontal space for *inner levels* and keyans, keyans* and keyanspic environments.

5.1 Keys for label and ref

mode-box ⟨*value forbidden*⟩ default: *not used*

This is a *"switch-key"* that does not receive an argument and is "only" available for the *"first level"* of the enumext environment and the enumext* environment. When this is set the label, font, wrap-label and wrap-label* keys are executed within \makebox for the enumext and keyans environments.

This key is intended for compatibility with *tagged* PDF and is forcibly *"enabled"* when \DocumentMetadata[9] is present. If you want to get the same document output whether \DocumentMetadata is active or not, you must enable this key.

In the enumext* and keyans* environments \makelabel is redefined using \makebox by default. If enumext or keyans is used in the enumext* environment the key must be activated manually.

label = {⟨\alph* | \Alph* | \arabic* | \roman* | \Roman*⟩} default: *by levels*

Sets the ⟨*label*⟩ that will be printed at the *current level* and default value for labelwidth key. The default value for the first level of the environments enumext and enumext* is \arabic*., for second level are (\alph*), for third level are \roman*. and for fourth level is \Alph*.. For keyans and keyans* environments the default value is \Alph*).

This key is intended to give the basic structure with which the ⟨*label*⟩ will be displayed, and the form in which it is used by standard *"label and ref"* and the *"internal label and ref"* system with the save-ref key. You cannot use commands with ⟨*label*⟩ as an argument, for example \emph{⟨\alph*⟩} will return an error. For full customization of how ⟨*label*⟩ is displayed use the font, wrap-label and/or wrap-label* keys.

labelsep = {⟨*rigid length*⟩} default: 0.3333*em*

Sets the *horizontal space* between the box containing the current ⟨*label*⟩ defined by label key and the text of an item on the first line. Internally sets the value of \labelsep for the current level.

labelwidth = {⟨*rigid length*⟩} default: *by label*

Sets the *width* of the label box containing the current ⟨*label*⟩ set by the label key. Internally sets the value of \labelwidth for the current level. The default values are calculated by means of the *width* of a box by setting a *value* to the current counter set by label key using '0' for \arabic*, 'M' for \Alph*, 'm' for \alph*, 'VIII' for \Roman* and 'viii' for \roman*.

widest = {⟨*integer* | *string*⟩} default: *empty*

Sets the labelwidth key passing the ⟨*integer*⟩ or converting the ⟨*string*⟩ of the form \Alph, \alph, \Roman or \roman to a *value* for the current counter defined by label key, then calculating the *width* by means of a box. For example widest={XXIII} or widest={23} are equivalent. This key is useful when the default values of the labelwidth key are smaller than those actually used.

font = {⟨*font commands*⟩} default: *empty*

Sets the *font style* for the current ⟨*label*⟩ defined by label key. You cannot use commands with an argument, for example font={\small\textbf{#1}} will return an error, but font={\bfseries\small} it will work. For full customization of how ⟨*label*⟩ is displayed use wrap-label and/or wrap-label* keys.

align = {⟨*left* | *right* | *center*⟩} default: *left*

Sets the *aligned* of ⟨*label*⟩ defined by label key on the current level in the label box of width set by labelwidth.

wrap-label = {⟨*code* {#1} *more code*⟩} default: *empty*

Wraps the *current* ⟨*label*⟩ defined by label key referenced by {#1} after executing the align and font keys. The {⟨*code*⟩} must be passed between braces and it does not modify the value set by the labelwidth key and is applied *only* on \item and \item*. When using it in the \setenumext command it is necessary to use the *double* '{##1}'. For example wrap-label={\fbox{#1}} or you can create a command:

```
\NewDocumentCommand \mywrap { s m }
  {
    \IfBooleanTF{#1}
      {\textcolor{red}{\textbf{Q}}\textcolor{blue}{\textbf{.}}\textcolor{gray}{#2}}
```

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```
    {\textcolor{blue}{\textbf{Q}}\textcolor{red}{\textbf{.}}\textcolor{gray}{#2}}
}
```

and then pass it through the key `wrap-label={\mywrap{#1}}` or `wrap-label={\mywrap*{#1}}`.

`wrap-label*` = {⟨*code* `{#1}` *more code*⟩} default: *empty*

The same as the `wrap-label` key but also applies on `\item[`⟨*custom*⟩`]`.

`ref` = {⟨*code* `{\alph*|\Alph*|\arabic*|\roman*|\Roman*}` *more code*⟩} default: *empty*

Modifies the way *cross references* are displayed. The `label` key sets the default form of the *cross references*, by using this key you can define a different format, for example: `ref=\emph{`⟨`\alph*`⟩`}` is valid.

Internally it renews the command associated with each counter when it is executed, i.e., in the environment `enumext` the command `\theenumXi` is modified when the key is executed at the first level, `\theenumXii` when it is executed at the second level and `\theenumXiii` together with `\theenumXiv` when it is executed at the third and fourth levels.

This must be kept in mind, since the values set by the `label` and `ref` keys are not cumulative by levels, so if you have used the `ref` key in the first level and then want to associate the counter with `label` or `ref` in the second level you must use the direct commands, i.e. `\arabic{enumXi}` to indicate the count of the first level instead of using `\theenumXi`.

5.2 Keys for penalties

Page breaks in the provided environments are controlled by the following three parameters, which work together to ensure they look good, avoiding unsightly page breaks that could distort the output.

`beginpenalty` = {⟨*integer*⟩} default: `-51`

Set the *page breaking* penalty for breaking at the beginning of the `enumext`, `enumext*`, `keyans` and `keyans*` environments. Internally sets the value of `\@beginparpenalty`.

`midpenalty` = {⟨*integer*⟩} default: `-51`

Set the *page breaking* penalty for breaking between items of the `enumext` and `keyans` environments. Internally sets the value of `\@itempenalty`. In the `enumext*` and `keyans*` environments the items are set inside the lines of a paragraph, so there is no vertical space between items where this penalty could be inserted and the key has no effect.

`endpenalty` = {⟨*integer*⟩} default: `-51`

Set the *page breaking* penalty for breaking at the end of the `enumext`, `enumext*`, `keyans` and `keyans*` environments. Internally sets the value of `\@endparpenalty`.

The values passed to these ⟨*keys*⟩ affect the nested environments in which they were set and cannot be reset. LaTeX default is `-\@lowpenalty`, that is, `-51`. Because it is negative, it somewhat encourages a page break at each spot. Change it with, e.g., `\@beginparpenalty=9999`; a value of `10000` prohibits a page break. Please, refer to your LaTeX or TeX manual about how penalties control page breaks.

5.3 Keys for spaces

`show-length` = {⟨*true* | *false*⟩} default: *false*

Displays on the terminal the values for *all list parameters* at the current level. For *vertical spaces* show the values of `\topsep`, `\itemsep`, `\parsep` and `\partopsep`. For *horizontal spaces* show the values of `\labelwidth`, `\labelsep`, `\itemindent`, `\listparindent` and `\leftmargin`.

5.3.1 Vertical spaces

`topsep` = {⟨*rubber length* | *rigid length*⟩} default: *by levels*

Set the *vertical space* added to both the top and bottom of the list. Internally sets the value of `\topsep` for the current level. The default value for the first level of the environments `enumext` and `enumext*` are `8.0pt plus 2.0pt minus 4.0pt`, for second level are `4.0pt plus 2.0pt minus 1.0pt`, for third and fourth level are `2.0pt plus 1.0pt minus 1.0pt`. For `keyans` and `keyans*` environments the default value is `4.0pt plus 2.0pt minus 1.0pt`.

`parsep` = {⟨*rubber length* | *rigid length*⟩} default: *by levels*

Set the *vertical space* between paragraphs within an item. Internally sets the value of `\parsep` for the current level. The default value for the first level of the environments `enumext` and `enumext*` are `4.0pt plus 2.0pt minus 1.0pt`, for second level are `2.0pt plus 1.0pt minus 1.0pt`, for third and fourth level are `0pt`. For `keyans` and `keyans*` environments the default value is `2.0pt plus 1.0pt minus 1.0pt`.

In the `enumext*` and `keyans*` environments this value is passed to `\parskip` within the `minipage` environment where *"item content"* is placed.

`partopsep` = {⟨*rubber length* | *rigid length*⟩} default: *by levels*

Set the *vertical space* added, beyond `topsep`, to the "top" and "bottom" of the entire environment if the environment instance is preceded by a *"blank line"* or `\par` command. Internally sets the value of `\partopsep` for the current level. The default values for first and second level in environment `enumext` are `2.0pt plus`

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1.0pt minus 1.0pt, for third and fourth level are 1.0pt minus 1.0pt. For the keyans environment the default value is 2.0pt plus 1.0pt minus 1.0pt, and for the keyans* and enumext* environments it is available but *without* effect.

The value of this parameter also affects the *inner levels* and the environments keyans, keyanspic and keyans*. Caution should be taken with *"blank lines"* or \par command *"before"* each environment or nested level when formatting the source code of document. TEX will enter ⟨*vertical mode*⟩ and apply this value to the "top" and "bottom" the environment or nested level.

itemsep = {⟨*rubber length* | *rigid length*⟩} default: *by levels*

Set the *vertical space* between items, beyond the parsep. Internally sets the value of \itemsep for the current level. The default value for the first level of the environments enumext and enumext* are 4.0pt plus 2.0pt minus 1.0pt, for the rest of the levels are 2.0pt plus 1.0pt minus 1.0pt. For keyans and keyans* environments the default value is 4.0pt plus 2.0pt minus 1.0pt.

In the enumext* and keyans* environments this value corresponds to the separation between rows.

noitemsep ⟨*value forbidden*⟩ default: *not used*

This is a *"meta-key"* that does not receive an argument. Set itemsep and parsep equal to 0pt the entire level of environment.

nosep ⟨*value forbidden*⟩ default: *not used*

This is a *"meta-key"* that does not receive an argument. Sets all keys for vertical spacing equal to 0pt the entire level of environment.

base-fix ⟨*value forbidden*⟩ default: *not used*

This is a *"switch-key"* that does not receive an argument available *only* for the *"first level"* of environment enumext. Fix the *baseline* when an environment enumext is nested in enumext* and there is no material between the \item and the start of the environment for example \item \begin{enumext} within the environment enumext*. Internally sets the keys topsep, above and above* at 0pt.

This key is provided as a way to work around this minor issue, but you should be aware that if for some reason you have the itemindent key set in the enumext* environment it will be lost and you will need to adjust it using the list-offset key in the enumext environment.

Extra vertical spaces

The following ⟨*keys*⟩ should be used with *"caution"*, they are intended to be used at the "top" and "bottom" of the environment when the columns or mini-env keys do not provide adequate *vertical spaces*. The values passed can be *rubber* or *rigid* lengths, the way they are applied is the way you differ, using the *star* '*' ⟨*keys*⟩ applies \vspace* so that LATEX does *not discard* this space at page break.

above = {⟨*rubber length* | *rigid length*⟩} default: *not used*

Set the *extra vertical space* added, beyond topsep, to the top of the entire level of environment. This key is intended to give a *"fine adjustment"* of the vertical space *"above"* the environment without hindering the value of the topsep key. The space is added with \vspace so is *"discardable"*.

above* = {⟨*rubber length* | *rigid length*⟩} default: *not used*

Set the *extra vertical space* added, beyond topsep, to the top of the entire level of environment. This key is intended to give a *"fine adjustment"* of the vertical space *"above"* the environment without hindering the value of the topsep key. The space is added with \vspace* so is *"not discardable"*.

below = {⟨*rubber length* | *rigid length*⟩} default: *not used*

Set the *extra vertical space* space added, beyond topsep, to the bottom of the entire level of environment. This key is intended to give a *"fine adjustment"* of the vertical space on the *"below"* the environment without hindering the value of the topsep key. The space is added with \vspace so is *"discardable"*.

below* = {⟨*rubber length* | *rigid length*⟩} default: *not used*

Set the *extra vertical space* space added, beyond topsep, to the bottom of the entire level of environment. This key is intended to give a *"fine adjustment"* of the vertical space on the *"below"* the environment without hindering the value of the topsep key. The space is added with \vspace* so is *"not discardable"*.

5.3.2 Horizontal spaces

list-offset = {⟨*rigid length*⟩} default: 0*pt*

Sets the *horizontal translation* of the entire environment level, that is, the distance from the left margin of the enclosing environment to the left edge of the box defined by the labelwidth key. It is the counterpart of the \labelindent parameter of enumitem (§1.2). Together with the list-indent key it sets the values of \leftmargin and \itemindent for the current level as follows:

\leftmargin = list-offset + list-indent
\itemindent = labelwidth + labelsep − list-indent

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`list-indent` = {⟨*rigid length*⟩} default: *labelwidth + labelsep*

Sets the *indentation* of the whole environment under the box defined by `labelwidth` and `labelsep` keys. Internally sets the value of `\leftmargin` and `\itemindent` for the current level. If `list-indent=0pt` is set in the environments `enumext` and `keyans` the ⟨*label*⟩ will be part of the text, separated by the value of the `labelsep` key and the *first word*, in simple terms it will look like a *"common paragraph"*.

The `enumext*` and `keyans*` environments are implemented using `\makebox` and `minipage` which causes *"list indent"* to always be equal to the value passed to `labelwidth` plus `labelsep`. Passing a value to this key is equivalent to setting the value for the `list-offset` key.

`itemindent` = {⟨*rigid length*⟩} default: *0pt*

Sets the extra *horizontal indentation*, beyond `labelsep`, of the *"first line"* of each `\item` that is not followed by a *"blank line"* or the `\par` command. This value must be greater than or equal to `0pt` and is applied internally using `\hspace` *without* modifying the value of `\itemindent`.

This key is intended for the `enumext*` and `keyans*` environments where, by their implementation, it is not possible to adjust `labelwidth` and `list-indent` *without* modifying the output. If you use `enumext` or `keyans` and want to get around the effect of a *blank line* or of the `\par` command followed by `\item` you can modify `labelwidth` and `list-indent` and get the same effect.

`rightmargin` = {⟨*rigid length*⟩} default: *0pt*

Set the *horizontal space* between the right margin of the environment and the right margin of the enclosing environment, the value it takes must be greater than or equal to `0pt`. Internally sets the value of `\rightmargin` for the current level.

`listparindent` = {⟨*rigid length*⟩} default: *0pt*

Sets the *horizontal space* indentation, beyond `list-indent`, for second and subsequent paragraphs within a list item. Internally sets the value of `\listparindent` for the current level.

In the `enumext*` and `keyans*` environments this value is passed to `\parindent` within the `minipage` environment where *"item content"* is placed.

5.4 Keys for add `code`

The following ⟨*keys*⟩ should be used with *"caution"*, they are intended to inject {⟨*code*⟩} into different parts of the defined environments. It must be kept in mind that the defined environments are based on the `list` base environment provided by LaTeX which is defined (simplified) as plain form `\list{`⟨*arg one*⟩`}{`⟨*arg two*⟩`}`. Using the `before*` key does not allow access to the `list` parameters defined by `[`⟨*key = val*⟩`]`.

`before` = {⟨*code*⟩} default: *not used*

Execute {⟨*code*⟩} *"before"* the environment starts. The {⟨*code*⟩} must be passed between braces, is executed *"after"* all calculations related to the *list parameters* in the environment and the ⟨*keys*⟩ sets by `[`⟨*key = val*⟩`]` have been performed, that is, in the *second argument* of the list: `\begin{list}{`⟨*arg one*⟩`}{`⟨*arg two*⟩`}{`⟨*code*⟩`}`.

`before*` = {⟨*code*⟩} default: *not used*

Execute {⟨*code*⟩} *"before"* the environment starts. The {⟨*code*⟩} must be passed between braces, is executed *"before"* performing all calculations related to the *list parameters* and the ⟨*keys*⟩ sets in `[`⟨*key = val*⟩`]` of the environment that is, *"before"* the arguments defining the list environment are executed: `{`⟨*code*⟩`}\begin{list}{`⟨*arg one*⟩`}{`⟨*arg two*⟩`}`.

`first` = {⟨*code*⟩} default: *not used*

Executes {⟨*code*⟩} when *"starting"* the environment. The {⟨*code*⟩} must be passed between braces, is executed right *"after"* all *list parameters* are done, after the second argument of list, just before the first occurrence of `\item`: `\begin{list}{`⟨*arg one*⟩`}{`⟨*arg two*⟩`}{`⟨*code*⟩`}\item`.

Keep in mind that the {⟨*code*⟩} set in this ⟨*key*⟩ will affect the entire *"body"* of the environment and therefore the inner levels of the list and the `keyans`, `keyans*` and `keyanspic` environments. It is recommended to set this ⟨*key*⟩ per level. In the `enumext*` and `keyans*` environments this ⟨*key*⟩ is executed *"after"* the `listparindent`, `parsep` and `itemindent` ⟨*keys*⟩ within the `minipage` environment in which the *"item content"* is placed. Making modifications to `\setcounter` in these environments using this ⟨*key*⟩ will not have the expected effect.

`after` = {⟨*code*⟩} default: *not used*

Execute {⟨*code*⟩} *"after"* finishing the environment. The {⟨*code*⟩} must be passed between braces.

5.5 Keys for `start`, `series` and `resume`

`start` = {⟨*integer* | *integer expression*⟩} default: *1*

Sets the *start value* of the numbering on the *"current level"*. The {⟨*integer expression*⟩} must be passed between braces, internally is evaluated and pass to the *"counter"* defined by `label` key on the current level, i.e. it is equivalent to enter `start={\dimeval{100*\value{chapter}}}` or `start={100*\value{chapter}}`.

`start*` = {⟨*integer* | *string*⟩} default: *not used*

Sets the *start value* of the numbering on the *"current level"*. Internally ⟨*string*⟩ is converted and passed as value to the *"counter"* defined by `label` key on the current level, i.e. it is equivalent to enter `start*=5`, `start*=E` or `start*=v`.

The *start value* in `enumext` and `keyans` are set in the *second argument* of the `list` environment and *"before"* the execution of the keys `before` and `first`, but in the `enumext*` and `keyans*` it is set much later: `\begin{list}{⟨arg one⟩}{⟨arg two⟩}\setcounter`.

The following ⟨*keys*⟩ are available only for the `enumext` and `enumext*` environments.

`series` = {⟨*series name*⟩} default: *not used*

Stores the *keys* of the *optional argument* of the *"current level"* of the environment in which it is executed in {⟨*series name*⟩} which is used as an *argument* in the `resume` key. The ⟨*keys*⟩ stored in {⟨*series name*⟩} are NOT cumulative and are overwritten if the same {⟨*series name*⟩} is used again at the *"same level"* at which the key was executed.

For security reasons the `series` key will never save in {⟨*series name*⟩} the ⟨*keys*⟩ `series`, `resume`, `resume*`, `reset`, `reset*`, `save-ans`, `save-key`, `start*` and `start`.

`resume` = {⟨*series name*⟩} default: *not used*

Sets the *start value* and *options* for the *"current level"* continuing the numbering and *options* of the *"same level"* as the environment in which the `series=`{⟨*series name*⟩} key was executed, the *start value* will continue numbering according to the last execution of `resume=`{⟨*series name*⟩}. If passed *"without value"* this will only set *start value* continue the numbering of the *"same level"* from the last environment and level in which `series=`{⟨*series name*⟩} or `resume=`{⟨*series name*⟩} is NOT present and if the `save-ans` key is active (on the left) it will continue the numbering from the "last" environment in which it was executed. The *start value* can be overwritten using `start` or `start*` keys.

The `resume` key passed *"without value"* must be exactly *"without value"*, i.e. `resume=` cannot be used and if executed before `resume*` it will affect the *start value*.

`resume*` ⟨*value forbidden*⟩ default: *not used*

Sets the *start value* and *options* for the *"current level"* continuing the numbering and options of the *"same level"* as the last environment and level in which the `series=`{⟨*series name*⟩} or `resume=`{⟨*series name*⟩} keys are NOT present and if the `save-ans` key is active (on the left) it will continue the numbering and options from the "last" environment in which it was executed. The *start value* can be overwritten using `start` or `start*` keys.

When using the key `resume=`{⟨*series name*⟩} or `resume*` you will have hierarchy in the ⟨*keys*⟩ that are stored in {⟨*series name*⟩} or in an internal version of {⟨*series name*⟩} in the case of `resume*`. If you want to *reset* the value of a ⟨*key*⟩ that is already stored in {⟨*series name*⟩} or in an internal version of {⟨*series name*⟩} this must be placed to the *right* of the key `resume=`{⟨*series name*⟩} or `resume*`.

When the `resume*` key is executed consecutively, it does not rewrite the ⟨*keys*⟩ stored in the internal version of {⟨*series name*⟩} and if the environment that precedes it does not have the *optional argument*, it will just continue with the numbering.

5.6 Keys for `reset`

`reset` ⟨*value forbidden*⟩ default: *not used*

Resets the *start value* of the *"counters"* in the `enumext` and `enumext*` environments along with the *"internal counters"* used by the `resume` *without value* and `resume*` keys at the *"level"* at which it is executed. The *start value* can be overwritten using the `start` or `start*` keys.

`reset*` ⟨*value forbidden*⟩ default: *not used*

Resets the *start value* of the *"counters"* in the `enumext` and `enumext*` environments along with the *"internal counters"* used by the `resume` *without value* and `resume*` keys at the *"level"* at which it is executed and in the *"levels below"* it in the case of the `enumext` environment. The *start value* can be overwritten using the `start` or `start*` keys.

These keys are intended to be used in cases where the `\resetenumext` command does not work, e.g. after an unnumbered chapter. It should preferably be set *only* on the *first level*, although it is available for all levels.

5.6.1 The command `\resetenumext`

`\resetenumext`

`\resetenumext[⟨1⟩]{⟨some counter⟩}`
`\resetenumext[⟨2⟩]{⟨some counter⟩}`
`\resetenumext[⟨3⟩]{⟨some counter⟩}`
`\resetenumext[⟨4⟩]{⟨some counter⟩}`
`\resetenumext[⟨*⟩]{⟨some counter⟩}`
`\resetenumext*{⟨some counter⟩}`

The `\resetenumext` command *"resets"* the *start value* of the *"counters"* for the `enumext` and `enumext*` environments along with the *"internal counters"* used by the keys `resume` *without value* and `resume*` according to the value of {⟨*some counter*⟩}. For example `\resetenumext{chapter}` will *"reset"* the numbering of *"all levels"* of the `enumext` environment for each execution of a *"numbered"* chapter.

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The *optional argument* of the form [1], [2], [3], [4] *"reset"* the values for levels 1, 2, 3 and 4 of the enumext environment, the form [*] *"reset"* the values for the enumext* environment. If is run *without* the *optional argument*, it will *"reset"* the values for *"all levels"* of the enumext environment.

The *starred argument* '*' will *"reset"* the values for *"all levels"* of the enumext and enumext* environments.

5.7 Keys for multicols

columns = {⟨*integer*⟩} default: 1

Set the *number of columns* to be used by the multicols environment within the environments enumext and keyans. The value must be a positive integer less than or equal to 10. In the enumext* and keyans* environments they correspond to the default number of columns (without joining) and internally adjust the value of \itemwidth.

columns-sep = {⟨*rigid length*⟩} default: *by level*

Set the *space between* columns used by the multicols environment within the environments enumext and keyans. Internally sets the value of \columnsep, by default its value is equal to the sum of the values set in the keys labelwidth and labelsep of the current level. In the enumext* and keyans* environments they correspond to the *space between* columns (without joining) and internally adjust the value of \itemwidth.

5.8 Keys for minipage

mini-env = {⟨*rigid length*⟩} default: *not used*

Sets the *width* of the minipage environment on the *"right side"*. This value added to the value set by the mini-sep key to determines the *width* of the minipage environment on the *"left side"*, taking \linewidth as the maximum reference value.

mini-sep = {⟨*rigid length*⟩} default: 0.3333em

Sets the *space between* the minipage environment on the *"left side"* and the minipage environment on the *"right side"*. This separation is applied together with \hfill.

5.8.1 The command \miniright

\miniright
```
\begin{enumext}[mini-env={⟨rigid length⟩}] ⟨items before⟩ \item \miniright ⟨content⟩ \end{enumext}
\begin{enumext}[mini-env={⟨rigid length⟩}] ⟨items before⟩ \item \miniright* ⟨content⟩ \end{enumext}
```

The \miniright command close the minipage environment on the *"left side"* and opens the minipage environment on the *"right side"* by starting it with the \centering command. It must be placed *"after"* the last \item of the current environment and *"before"* starting the material to be placed on the *"right side"*.

The *starred argument* '*' inhibits the use of \centering command i.e. the usual LaTeX justification is maintained in the minipage on the *"right side"*.

5.8.2 The key mini-right

In the *horizontal list environments* enumext* and keyans* it is not possible to use the \miniright command and the mini-right key must be used instead.

mini-right = {⟨*content*⟩} default: *not used*

Set the *content* for the drawing or tabular to be placed in the minipage environment on the *"right side"* by starting it with \centering. The {⟨*content*⟩} must be passed between braces.

mini-right* = {⟨*content*⟩} default: *not used*

Same as above, but *without* starting with \centering.

6 The storage system

The entire mechanism for *"storing content"* it is activated according to save-ans key on the *"first level"* of enumext or enumext* environments and it is ignored if they are established when they are nested inside each other. Only when this ⟨*key*⟩ is *"active"* the \anskey command and the environments anskey*, keyans, keyans* and keyanspic are available.

```
\begin{enumext}[save-ans={⟨store name⟩}]
  \item Text \anskey{answer}
  \item Text
    \begin{keyans}
          ...
    \end{keyans}
\end{enumext}
```

```
\begin{enumext}[save-ans={⟨store name⟩}]
  \item Text \anskey{answer}
  \item Text
    \begin{keyanspic}
          ...
    \end{keyanspic}
\end{enumext}
```

By executing the key save-ans={⟨*store name*⟩} the entire *"structure"* of the environment (excluding the *first level*) including the *optional argument* passed to the inner levels or the environment nested in it, along with the ⟨*content*⟩ passed to \anskey or anskey*, the current ⟨*labels*⟩ for \item* and \anspic* in the environments

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keyans, keyans* and keyanspic will be *"stored"* in a *sequence* {⟨*store name*⟩} and at the same time will be *"stored"* (without the *"structure"* or *optional argument*) in a *prop list* {⟨*store name*⟩}.

For security reasons the *optional argument* of the inner levels or the nested environment are *filtered* by excluding all ⟨*keys*⟩ related to the *"storage system"* (§6.1) along with the keys mini-env, mini-sep, mini-right, mini-right*, series, resume and resume* when storing in *sequence* {⟨*store name*⟩} set by save-ans key.

6.1 Keys for storage system

The only ⟨*keys*⟩ available for all levels of the enumext environment and the enumext* environment are no-store and save-key, the rest of the ⟨*keys*⟩ described in this section must be passed directly in the *optional argument* of the *"first level"* of the environment in which the key save-ans is executed. The key save-ans should NOT be passed with the command \setenumext.

save-ans = {⟨*store name*⟩} default: *not set*

Sets the *name* of the *sequence* and *prop list* in which the {⟨*contents*⟩} will be *"stored"* by \anskey and anskey* in enumext and enumext* environments and the current ⟨*labels*⟩ for \item* and \anspic* in the environments keyans, keyans* and keyanspic. If the *sequence* or *prop list* {⟨*store name*⟩} does not exist, it will be created globally and will not be *overwritten* if the key is used again.

save-key = {⟨*key list*⟩} default: *not set*

This key *overrides* the default *"stored keys"* of the *optional argument* of the inner levels or nested environment that will be passed to the *sequence* {⟨*store name*⟩} set by save-ans key. The ⟨*key list*⟩ passed to this key ignores any ⟨*keys*⟩ in the *"stored structure"* and must be passed between braces. For example, if executed at a second level:

```
\begin{enumext}[save-ans={⟨store name⟩}]
  \item Text \anskey{answer}
  \item Text
    \begin{enumext}[nosep, columns=2, save-key={columns=3}]
          ...
    \end{enumext}
\end{enumext}
```

The *"stored keys"* by default in the *sequence* {⟨*store name*⟩} would be nosep and columns=2, but using the key save-key={columns=3} will overwrite and the *"stored key"* in the *sequence* {⟨*store name*⟩} are only columns=3 ignoring all the others.

save-sep = {⟨*text symbol*⟩} default: *{, }*

Sets the *text symbol* that will separate the current ⟨*label*⟩ to the *optional argument* passed to the \item* and \anspic* in the environments keyans, keyans* and keyanspic and storing them in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key. The {⟨*text symbol*⟩} must always be passed between braces, whitespace '␣' is preserved within the braces and only affects the *"stored content"* and not what is displayed when using the show-ans or show-pos keys.

no-store ⟨*value forbidden*⟩ default: *not used*

This is a *"switch-key"* that does not receive an argument and disables the *"storing content"* in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key at the entire level or a nested environment in which it runs. This key is intended for use in internal levels or nested enumext or enumext* environments in which you want to use enumext or enumext* but *"without"* using the \anskey command or use anskey* environment and *"without"* interfering with the check-ans key.

6.1.1 Keys for label and ref

save-ref = {⟨*true* | *false*⟩} default: *false*

Activates the *"internal label and ref"* mechanism for referencing *"stored content"* in *prop list* {⟨*store name*⟩} set by save-ans key. To reference the location of the *"stored content"* within the environment you must use \ref{⟨*store name* : *position*⟩}, where ⟨*position*⟩ corresponds to the position occupied by the *"stored content"* in the *prop list* {⟨*store name*⟩} returned by the show-pos key. For example \ref{test:4} will return 3.(b) which corresponds to the location of the *"stored content"* at position 4 in *prop list* test within the environment in which the key save-ans=test was set.

mark-ref = {⟨*symbol*⟩} default: *\textreferencemark*

Sets the *symbol* that will be displayed by the \printkeyans command only if the hyperref package is detected and the save-ref key are active. This *"symbol"* is used as a *"link"* between the environment in which the save-ans key was used and the place where the command is executed.

6.1.2 Keys for wrap and marks

The enumext package provides a set of ⟨*keys*⟩ to set and manipulate *"symbol marks"* associated with *"answers"* and how they are displayed and stored in the *sequence* and *prop list*.

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The ⟨*keys*⟩ available for the \anskey command and the anskey* environment can be passed *"only"* in the *optional argument* in the *"first level"* of the enumext or enumext* environment.

The ⟨*keys*⟩ available for the keyans and keyans* environments can be passed locally in the *optional argument*, at the *"first level"* of the enumext or enumext* environment or via the \setenumext command with one minor difference, when ⟨*keys*⟩ are passed through the *"first level"* of the enumext or enumext* environment they are set in *"both"* environments, but when they are passed using the \setenumext command they are set *"individually"* in each environment.

show-ans = {⟨*true* | *false*⟩} default: *false*

Display the *symbol* set by the mark-ans key to the left of the *mandatory argument* ⟨*content*⟩ passed to the \anskey command and ⟨*body*⟩ for the anskey* environment using the wrap-ans key if set. For \item* and \anspic* the keyans, keyans* and keyanspic environments it will display the *symbol* set by the mark-ans* key to the left of the current ⟨*label*⟩ and *optional argument*. If the *optional argument* is present in \item* or \anspic* it will be shown using wrap-opt key.

Keys for \anskey and anskey*

mark-ans = {⟨*symbol*⟩} default: *\textasteriskcentered*

Sets the *symbol* to be displayed in the left margin for \anskey command and anskey* environment when using the key show-ans. The *"symbol"* is placed in a box of width equal to the value of labelwidth at the current level, separated by the value of the key mark-sep and aligned by the value of the key mark-pos. This key is not affected by the keys font or wrap-label so if you want to apply *styling* you have to do it directly, for example: mark-ans={\textcolor{red}{\textbf{\textasteriskcentered}}.

mark-pos = {⟨*left* | *right* | *center*⟩} default: *right*

Sets the *aligned* of the *"symbol"* defined by mark-ans key for \anskey command and anskey* environment. The *"symbol"* is aligned in a box with the same dimensions of the label box defined by labelwidth key on the current level and separated by the value of the mark-sep key.

mark-sep = {⟨*rigid length*⟩} default: *labelsep*

Sets the *horizontal space* between the box containing the *"symbol"* defined by mark-ans key and the *mandatory argument* ⟨*content*⟩ passed to the \anskey command and the ⟨*body*⟩ in anskey* environment.

wrap-ans = {⟨*code* {#1} *more code*⟩} default: *\fbox+\parbox{#1}*

Wraps the *mandatory argument* ⟨*content*⟩ passed to the \anskey and the ⟨*body*⟩ in anskey* environment referenced by {#1} when using the show-ans or show-pos keys. The {⟨*code*⟩} must be passed between braces and only affects how the ⟨*content*⟩ or ⟨*body*⟩ is displayed and NOT the *"stored content"* in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key. If this key is passed using \setenumext it is necessary to use double '{##1}'.

Keys for keyans, keyans* and keyanspic

mark-ans* = {⟨*symbol*⟩} default: *\textasteriskcentered*

Sets the *symbol* to be displayed in the left margin for \item* and \anspic* for the keyans, keyans* and keyanspic environments when using the key show-ans. The *"symbol"* is placed in a box of width equal to the value of labelwidth of the environment in which it is executed, separated by the value of the key mark-sep* and aligned by the value of the key mark-pos*. This key is not affected by the keys font or wrap-label so if you want to apply *styling* you have to do it directly, for example: mark-ans*={\textcolor{red}{\textbf{\textasteriskcentered}}.

mark-pos* = {⟨*left* | *right* | *center*⟩} default: *right*

Sets the *aligned* of the *"symbol"* defined by mark-ans* key for the keyans, keyans* and keyanspic environments. The *"symbol"* is aligned in a box with the same dimensions of the label box defined by labelwidth key of the environment in which it is executed and separated by the value of the mark-sep* key.

mark-sep* = {⟨*rigid length*⟩} default: *labelsep*

Sets the *horizontal space* between the box containing the *"symbol"* defined by mark-ans* key and the current ⟨*label*⟩ for \item* and \anspic* in the keyans, keyans* and keyanspic environments.

wrap-ans* = {⟨*code* {#1} *more code*⟩} default: *not used*

Wraps the *current* ⟨*label*⟩ when using the show-ans key for \item* and \anspic* referenced by {#1} in the keyans, keyans* and keyanspic environments after executing the align and font keys. The {⟨*code*⟩} must be passed between braces and *only* affects how the ⟨*label*⟩ is displayed and NOT the *"stored label"* in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key. This key overwrites the key wrap-label and if is passed using \setenumext it is necessary to use double '{##1}'. For example, if you want the ⟨*label*⟩ to be displayed in red when using show-ans you just set wrap-ans*={\textcolor{red}{#1}}.

wrap-opt = {⟨*code* {#1} *more code*⟩} default: *[{#1}]*

Wraps the *optional argument* passed to the \item* and \anspic* referenced by {#1} in the keyans, keyans* and keyanspic environments when using the show-ans or show-pos keys. The {⟨*code*⟩} must be passed between braces and only affects the current *optional argument* and NOT the *"stored content"* in the *sequence*

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and *prop list* {⟨*store name*⟩} set by save-ans key. If this key is passed using \setenumext it is necessary to use double '{##1}'.

6.1.3 Keys for debug and checking

show-pos = {⟨*true* | *false*⟩} default: *false*

Displays the *position* occupied by the *"stored content"* by \anskey, anskey*, \item* and \anspic* in the *prop list* {⟨*store name*⟩} set by save-ans key. This position is used by the \getkeyans command and by the \ref command if the save-ref key is active.

check-ans = {⟨*true* | *false*⟩} default: *false*

Enables the *checking answer* mechanism: a warning is shown on the terminal when the number of items and answers differ, and the result is written to the .log file. This key works under the logic that each \item or \item* that does not open an inner level or nested environment contains *"only one answer"* or *"only one execution"* of the \anskey or anskey*. It is intended to be used in conjunction with the no-store key.

6.2 The command \anskey

\anskey \anskey[⟨*keys*⟩]{⟨*content*⟩}

The command \anskey takes a mandatory non empty argument {⟨*content*⟩} and *"stores"* it in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key. By design the command cannot be nested or passed *verbatim material* in the argument and it is assumed that each *numbered* \item or \item* within the environment in which it is active it has a *"single execution"* of \anskey unless \item or \item* open a nested level or use the no-store key.

If save-ref key are active and the hyperref[10] package is detected, \hyperlink and \hypertarget will be used, otherwise the usual *"label and ref"* system provided by LaTeX will be used.

The \anskey command is available for all levels of the enumext environment and the enumext* environment, but is disabled for the keyans, keyans* and keyanspic environments.

6.2.1 Keys for \anskey

By default the *mandatory argument* ⟨*content*⟩ passed to \anskey when *"storing"* in the *sequence* {⟨*store name*⟩} has the form \item ⟨*content*⟩, the following ⟨*keys*⟩ allow modifying the way in which it is *"stored"* in the *sequence*.

break-col ⟨*value forbidden*⟩ default: *not used*

Stores {⟨*content*⟩} in the *sequence* {⟨*store name*⟩} of the form \columnbreak \item ⟨*content*⟩.

item-join = {⟨*columns*⟩} default: *not set*

Set the *number of columns* to be used for \item(⟨*columns*⟩) and stores {⟨*content*⟩} in the *sequence* {⟨*store name*⟩} of the form \item(⟨*columns*⟩) ⟨*content*⟩.

item-star ⟨*value forbidden*⟩ default: *not used*

Stores {⟨*content*⟩} in the *sequence* {⟨*store name*⟩} of the form \item* ⟨*content*⟩.

item-sym* = {⟨*symbol*⟩} default: *not set*

Sets the *symbol* for \item* when using the key item-star and stores {⟨*content*⟩} in the *sequence* {⟨*store name*⟩} of the form \item*[⟨*symbol*⟩] ⟨*content*⟩. The *symbol* can be in text or math mode, for example item-sym*={$\ast$} stores \item*[$\ast$] ⟨*content*⟩.

item-pos* = {⟨*rigid length*⟩} default: *not set*

Sets the *offset* for \item* when using the keys item-star and item-sym* and stores {⟨*content*⟩} in the *sequence* {⟨*store name*⟩} of the form \item*[⟨*symbol*⟩][⟨*offset*⟩] ⟨*content*⟩.

Example

```
\begin{enumext}[save-ans=test,show-ans=true]
  \item* Text containing our instructions or questions. \anskey{⟨first answer⟩}
  \item Text containing our instructions or questions.
    \begin{enumext}
      \item Question.\anskey{⟨second answer⟩}
    \end{enumext}
  \item Text containing our instructions or questions. \anskey{⟨third answer⟩}
  \item Text containing our instructions or questions. \anskey{⟨fourth answer⟩}
\end{enumext}
```

⋆ 1. Text containing our instructions or questions.
∗ first answer
2. Text containing our instructions or questions.
(a) Question.
∗ second answer
3. Text containing our instructions or questions.
∗ third answer
4. Text containing our instructions or questions.
∗ fourth answer

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6.3 The environment anskey*

anskey* `\begin{anskey*}[⟨key = val⟩] ⟨body content⟩ \end{anskey*}`

The environment anskey* takes a mandatory {⟨*body content*⟩} and *"stores it"* in the *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key. If save-ref key are active and the hyperref[10] package is detected \hyperlink and \hypertarget will be used, otherwise the usual *"label and ref"* system provided by LaTeX will be used.

By design the environment cannot be nested but full supports *"verbatim material"* in the ⟨*body*⟩ and it is assumed that *"each numbered"* \item or \item* within the environment in which it is active it has a *"single execution"* unless \item or \item* open a nested level or use the no-store key.

The anskey* environment is implemented using the new *"collect code"* c-type argument part of LaTeX release 2025-06-01[11]. \begin{anskey*} and \end{anskey*} must be in different lines and should not appear within verbatim environments or commands. All ⟨*keys*⟩ must be passed separated by commas and "without separation" of the start of the environment.

Comments '%' or *any character* after \begin{anskey*} or [⟨*key = val*⟩] on the same line are NOT supported, LaTeX will return an "error" message if this happens. In a similar way comments '%' or *any character* after \end{anskey*} on the same line LaTeX will return a "warning" message.

6.3.1 Keys for anskey*

The anskey* environment uses the same ⟨*keys*⟩ as the \anskey command next to the ⟨*keys*⟩ write-env, overwrite and force-eol. The environment is available for all levels of the enumext environment and the enumext* environment, but it is disabled for the keyans, keyans* and keyanspic environments.

write-env = {⟨*file.ext*⟩} default: *not used*

Sets the *name* of the ⟨*external file*⟩ in which the ⟨*contents*⟩ of the environment will be written. The ⟨*file.ext*⟩ will be created in the working directory, relative or absolute paths are not supported. If ⟨*file.ext*⟩ does not exist, it will be created or overwritten if the overwrite key is used.

overwrite = {⟨*true* | *false*⟩} default: *false*

Sets whether the ⟨*file.ext*⟩ generated by write-env from the anskey* environment will be rewritten.

force-eol = {⟨*true* | *false*⟩} default: *false*

Sets if the *last end of line* for the ⟨*stored content*⟩ is hidden or not. This key is necessary only if the last line is the closing of some environment defined by the fancyvrb package as \end{Verbatim} or another environment that does not support a comments '%' after closing \end{Verbatim}%.

Example

```
\begin{enumext}[save-ans=test,show-pos=true,start=5]
  \item* Text containing our instructions or questions.
    \begin{anskey*}[item-star]
      ⟨first answer⟩
    \end{anskey*}

  \item Text containing our instructions or questions.
    \begin{enumext}
      \item Question.
        \begin{anskey*}
          ⟨second answer⟩
        \end{anskey*}
    \end{enumext}

  \item Text containing our instructions or questions.
    \begin{anskey*}
      ⟨third answer⟩
    \end{anskey*}

  \item Text containing our instructions or questions.
    \begin{anskey*}
      ⟨fourth answer⟩
    \end{anskey*}
\end{enumext}
```

⋆ 5. Text containing our instructions or questions.
[5] First answer with verbatim
6. Text containing our instructions or questions.
(a) Question.
[6] second answer
7. Text containing our instructions or questions.
[7] third answer
8. Text containing our instructions or questions.
[8] fourth answer

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6.4 The environments keyans and keyans*

keyans `\begin{keyans}[⟨key = val⟩] \item \item[⟨custom⟩] \item* \item*[⟨content⟩] \end{keyans}`
keyans* `\begin{keyans*}[⟨key = val⟩] \item \item[⟨custom⟩] \item* \item*[⟨content⟩] \end{keyans*}`

The keyans and keyans* environments are *"enumerated list"* environments designed for *"multiple choice"* questions activated by the save-ans key.

This environments can NOT be nested and must always be at the *"first level"* of the enumext environment, the commands \item and \item[⟨custom⟩] work in the usual and the command \item(⟨columns⟩) is available for the keyans* environment.

The behavior of \item* in keyans and keyans* environments is NOT the same as in the enumext or enumext* environments.

```
\begin{enumext}[save-ans=test]
  \item ⟨item content⟩
    \begin{keyans}[⟨key = val⟩]
      \item ⟨item content⟩
      \item [⟨custom⟩] ⟨item content⟩
      \item* ⟨item content⟩
      \item*[⟨content⟩] ⟨item content⟩
    \end{keyans}
\end{enumext}
```

```
\begin{enumext}[save-ans=test]
  \item ⟨item content⟩
    \begin{keyans*}[⟨key = val⟩]
      \item ⟨item content⟩
      \item [⟨custom⟩] ⟨item content⟩
      \item* ⟨item content⟩
      \item*[⟨content⟩] ⟨item content⟩
    \end{keyans*}
\end{enumext}
```

The ⟨keys⟩ set in the *optional argument* of the environment are the same (almost) as those of the enumext and enumext* environments and have *higher precedence* than those set by \setenumext[⟨keyans⟩]{⟨key = val⟩} or \setenumext[⟨keyans*⟩]{⟨key = val⟩}. If the *optional argument* is not passed or the ⟨keys⟩ are not set by \setenumext, the default values will be the same as the *"second level"* of the enumext environment with the difference in the ⟨label⟩ which will be set to label=\Alph*).

The keys mark-ans*, mark-pos*, mark-sep*, save-sep, wrap-opt, wrap-ans*, show-ans and show-pos are available for both environments.

6.4.1 The \item* in keyans and keyans*

\item* `\item*`
`\item*[⟨content⟩]`

The \item* and \item*[⟨content⟩] command *"store"* the current ⟨label⟩ set by label key next to the *optional argument* ⟨content⟩ in *sequence* and *prop list* {⟨store name⟩} set by save-ans key in the *"first level"* of the enumext or enumext* environments.

The *starred argument* '*' cannot be separated by spaces '␣' from the command, i.e. \item* and the *optional argument* does "NOT" support *verbatim content*. By design it is assumed that the \item* will only appear *"once"* within the environment.

Example

```
\begin{enumext}[save-ans=test,columns=2,show-ans=true]
  \item Text containing a question.

    \begin{keyans*}[nosep,columns=2]
      \item Choice
      \item* Correct choice
      \item Choice
      \item Choice
      \item Choice
    \end{keyans*}

  \item Text containing a question and image.

    \begin{keyans}[nosep,mini-env={0.4\linewidth}]
      \item Choice
      \item Choice
      \item Choice
      \item Choice
      \item*[⟨note⟩] Correct choice
      \miniright
      \includegraphics[scale=0.25]{example-image-a}
      Some text
    \end{keyans}
\end{enumext}
```

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1. Text containing a question.
   A) Choice
   ∗ B) Correct choice
   C) Choice
   D) Choice
   E) Choice

2. Text containing a question and image.
   A) Choice
   B) Choice
   C) Choice
   D) Choice
   ∗ E) [note] Correct choice



Some text

6.5 The environment keyanspic

keyanspic `\begin{keyanspic}[⟨key = val⟩] \anspic*[⟨content⟩]{⟨drawing or tabular⟩} \end{keyanspic}`

The keyanspic environment is an *"enumerated list"* environment activated by the save-ans key that has the same configuration for *"spacing"* and ⟨*label*⟩ as the keyans environment that uses the \anspic command instead of \item. It is intended for placing *drawings or tabular* with ⟨*label*⟩ centered *above* or *below* in a *single line* or *upper and lower* layout style.

When the keyanspic environment is used *without keys* the ⟨*labels*⟩ are centered *below* the *drawings or tabular* in a *single line* layout style.

A representation of the output can be seen in the figure 6.

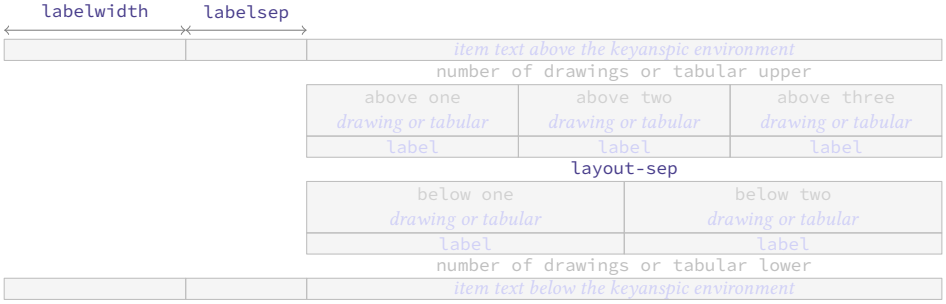

Figure 6: Representation of the keyanspic environment with layout-sty={⟨*3, 2*⟩} in enumext.

This environment cannot be nested and must *always* be at the *"first level"* of the enumext environment, the \item command is disabled and ⟨*keys*⟩ cannot be set using \setenumext.

6.5.1 Keys for keyanspic

label-pos = {⟨*above* | *below*⟩} default: *below*

Set the *position* of ⟨*label*⟩ to be centered "above" or "below" *drawings* or *tabular* when the \anspic command is executed.

label-sep = {⟨*rubber length* | *rigid length*⟩} default: *1pt above* | *5pt below*

Set the *vertical spacing* between the ⟨*label*⟩ centered "above" or "below" and *drawings* or *tabular* when running the \anspic command. The value is the exact distance between the ⟨*label*⟩ and the *drawing or tabular*, with any font size.

layout-sty = {⟨*n° upper , n° lower*⟩} default: *not set*

Set the *number* of *drawings* or *tabular* that will be distributed "upper" and "lower" within the environment when executing the \anspic command. The value must be passed in braces and if not set or the ⟨*n° lower*⟩ is omitted the *drawings* or *tabular* will be put on a *single line*.

layout-sep = {⟨*rubber length* | *rigid length*⟩} default: *parsep from keyans*

Set the *vertical separation* between the number of *drawings* or *tabular* placed at the "upper" and "lower" within the environment when executing the \anspic command. Internally sets the parsep value taken from the keyans environment. The value is the exact distance between the rows, with any font size.

layout-top = {⟨*rubber length* | *rigid length*⟩} default: *topsep from keyans*

Set the *vertical space* added to both the top and bottom of the environment. The value is the exact distance between the environment and the neighbouring lines, with any font size. If it is not set, the space above and below is the same as in the keyans environment.

The keys mark-ans*, mark-pos*, mark-sep*, save-sep, wrap-opt, wrap-ans*, show-ans and show-pos are available for this environment.

6.5.2 The command \anspic

\anspic `\anspic{⟨drawing or tabular⟩}`
`\anspic*[⟨content⟩]{⟨drawing or tabular⟩}`

The \anspic command takes three arguments, the *starred argument* '*' store the current ⟨*label*⟩ next to the *optional argument* ⟨*content*⟩ in *sequence* and *prop list* {⟨*store name*⟩} set by save-ans key.

The *starred argument* '*' cannot be separated by spaces '␣' from the command, i.e. \anspic* and the *optional argument* does "NOT" support *verbatim content*. By design it is assumed that the *starred argument* '*' will only appear *"once"* within the environment.

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Example

```
\begin{enumext}[save-ans=test,show-ans=true,nosep]
  \item Question with images and labels below.

    \begin{keyanspic}[layout-sty={3,2}]
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-b}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic*[note]{\includegraphics[scale=0.15]{example-image-a}}
    \end{keyanspic}

  \item Question with images and labels above.

    \begin{keyanspic}[label-pos=above, layout-sty={3,2},layout-sep=0.25cm]
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-b}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic*[note]{\includegraphics[scale=0.15]{example-image-a}}
    \end{keyanspic}

  \item Question with images and labels below on a single line.

    \begin{keyanspic}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-b}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic{\includegraphics[scale=0.15]{example-image-a}}
      \anspic*[note]{\includegraphics[scale=0.15]{example-image-a}}
    \end{keyanspic}

\end{enumext}
```

1. Question with images and labels below.



A)



B)



C)



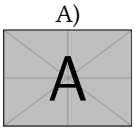
D)



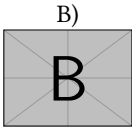
∗ E) [note]

2. Question with images and labels above.

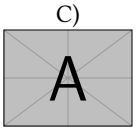
A)



B)



C)



D)



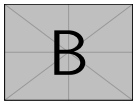
∗ E) [note]



3. Question with images and labels below on a single line.



A)



B)



C)



D)



∗ E) [note]

Remember to pass the `alt={`*description*`}` key to the `\includegraphics` command when creating a *tagged* PDF.

6.6 Printing stored content

6.6.1 The command \getkeyans

\getkeyans `\getkeyans{⟨store name : position⟩}`

The command \getkeyans prints the *"stored content"* in *prop list* {⟨*store name*⟩} defined by save-ans key in the ⟨*position*⟩ returned by the show-pos key.

The *"stored content"* can only be accessed *after* it is stored, if {⟨*store name*⟩} does not exist the command will return an error.

The form taken by the argument {⟨*store name : position*⟩} is the same as that used to generate the *"internal label and ref"* system when save-ref key are active, so to refer to a *"stored content"*. For example \getkeyans{test:4} will return the *"stored content"* at position 4 of the environment in which the key save-ans=test was set.

6.6.2 The command \foreachkeyans

\foreachkeyans `\foreachkeyans[⟨key = val⟩]{⟨store name⟩}`

The command \foreachkeyans goes through and executes the command \getkeyans on the contents in *prop list* {⟨*store name*⟩}. If you pass without options run \getkeyans on all contents in *prop list* {⟨*store name*⟩}.

Options for command

sep = {⟨*code*⟩} default: *{;}*

Establishes the *separation* between *"each"* {⟨*content*⟩} stored in *prop list* {⟨*store name*⟩}. For example, you can use sep={\\[10pt]} for vertical separation of stored contents.

step = {⟨*integer*⟩} default: *1*

Sets the *step* (increment) applied to the value set by key start for *"each"* {⟨*content*⟩} stored in *prop list* {⟨*store name*⟩}. The value must be a ⟨*positive integer*⟩.

start = {⟨*integer*⟩} default: *1*

Sets the *position* of the *prop list* {⟨*store name*⟩} from which execution will start. The value must be a ⟨*positive integer*⟩.

stop = {⟨*integer*⟩} default: 0

Sets the *position* of the *prop list* {⟨*store name*⟩} from which execution will finish. The value must be a ⟨*positive integer*⟩.

before = {⟨*code*⟩} default: *empty*

Sets the {⟨*code*⟩} that will be executed ⟨*before*⟩ each {⟨*content*⟩} stored in *prop list* {⟨*store name*⟩}. The {⟨*code*⟩} must be passed between braces.

after = {⟨*code*⟩} default: *empty*

Sets the {⟨*code*⟩} that will be executed ⟨*after*⟩ each {⟨*content*⟩} stored in *prop list* {⟨*store name*⟩}. The {⟨*code*⟩} must be passed between braces.

wrapper = {⟨*code* {#1} *more code*⟩} default: *empty*

Wraps the {⟨*content*⟩} stored in *prop list* {⟨*store name*⟩} referenced by {#1}. The {⟨*code*⟩} must be passed between braces. For example \foreachkeyans[wrapper={\makebox[1em][l]{#1}}]{⟨*store name*⟩}.

6.6.3 The command \printkeyans

\printkeyans
```
\printkeyans{⟨store name⟩}
\printkeyans[⟨keys⟩]{⟨store name⟩}
\printkeyans*[⟨keys⟩]{⟨store name⟩}
```

The command \printkeyans prints *"all stored content"* in *sequence* {⟨*store name*⟩} defined by save-ans key placing this inside the enumext or enumext* environment if the *starred argument* '*' is used.

The *"stored content"* can only be accessed *after* it is stored in the *sequence*, if {⟨*store name*⟩} does not exist the command will return an error.

The *optional argument* allows managing the ⟨*keys*⟩ in the *"first level"* of the environment in which the *"stored content"* of the *sequence* {⟨*store name*⟩} will be printed, if the *starred argument* '*' is used it will be enumext* otherwise enumext.

The default values for the *"first level"* are the same as the default values for the enumext and enumext* environments along with the keys nosep,first=\small,font=\small and columns=2. For the inner levels of the environment enumext saved in the *sequence* {⟨*store name*⟩} the default values are the same as those established for the second, third and fourth levels plus the keys nosep,first=\small,font=\small. If the environment enumext* is saved within the *sequence* {⟨*store name*⟩} it will have the same default values plus the keys nosep,first=\small, font=\small. These are the default values of the package: the values set with \setenumext for the environments enumext and enumext* do not modify them.

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Since the command encapsulates by default the enumext environment or the enumext* environment, some considerations must be taken into account:

- If \printkeyans*{⟨store name⟩} is executed and the *sequence* {⟨store name⟩} already contains any enumext* environment an error will be returned, since nesting is not possible.
- If \printkeyans*{⟨store name⟩} is executed and the *sequence* {⟨store name⟩} contains any enumext environments, they will start with the ⟨keys⟩ set for the first level unless they are set in the *optional argument* or save-key is used to modify it.
- If \printkeyans{⟨store name⟩} is executed and the *sequence* {⟨store name⟩} contains any environment enumext*, they will start with the ⟨keys⟩ set by default unless they are set in the *optional argument* or save-key is used to modify it.

The default values for the *"first level"* of \printkeyans commands and \printkeyans* are established using \setenumext[⟨print , 1⟩]{⟨keys⟩} and \setenumext[⟨print*⟩]{⟨keys⟩}.

To set the ⟨keys⟩ for the environment enumext "saved" in the *sequence* {⟨store name⟩}, use \setenumext[⟨print , level⟩]{⟨keys⟩}, and to set the ⟨keys⟩ for the environment enumext* "saved" in the *sequence* {⟨store name⟩}, use \setenumext[⟨print , *⟩]{⟨keys⟩}.

Example

```
\begin{enumext}[save-ans=sample,columns=1,show-pos=true,nosep,save-ref=true]
  \item Factor $3x+3y+3z$. \anskey{$3(x+y+z)$}
  \item True False

    \begin{enumext}[nosep]
      \item \LaTeX2e\ is cool? \anskey{Very True!}
    \end{enumext}

  \item Related to Linux

    \begin{enumext}[nosep]
      \item You use Linux? \anskey{Yes}
      \item Rate the following package and class
        \begin{enumext}[nosep]
          \item \texttt{xsim} \anskey{very good}
          \item \texttt{exsheets} \anskey{obsolete}
        \end{enumext}
    \end{enumext}
\end{enumext}

The answer to \ref{sample:4} is \getkeyans{sample:4} and the answers to
all the worksheets are as follows:

\printkeyans{sample}
```

1. Factor $3x + 3y + 3z$.

[1] $3(x + y + z)$

2. True False
   (a) LaTeX2e is cool?

   [2] Very True!

3. Related to Linux
   (a) You use Linux?

   [3] Yes

   (b) Rate the following package and class
      i. `xsim`

      [4] very good

      ii. `exsheets`

      [5] obsolete

The answer to 3.(b).i is very good and the answers to all the worksheets are as follows:

1. $3(x + y + z)$ ※
2. (a) Very True! ※
3. (a) Yes ※
   (b) i. very good ※
   ii. obsolete ※

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7 Full examples

Some adapted questions taken from TeX-SX are included as an example. The source files of the examples can be compiled with the excellent arara[1] tool.

Example 1

Adapted from the response given by Enrico Gregorio in Squares for answer choice options and perfect alignment to mathematical answers. Source file.

1. La velocità di $1{,}00 \times 10^2$ m/s espressa in km/h è:
   - A 36 km/h.
   - B 360 km/h.
   - C $27{,}8$ km/h.
   - D $3{,}60 \times 10^8$ km/h.
2. In fisica nucleare si usa l'angstrom (simbolo: $1\,\text{Å} = 1 \times 10^{-10}$ m) e il fermi o femtometro ($1\,\text{fm} = 1 \times 10^{-15}$ m). Qual è la relazione tra queste due unità di misura?
   - A $1\,\text{Å} = 1 \times 10^{5}$ fm.
   - B $1\,\text{Å} = 1 \times 10^{-5}$ fm.
   - C $1\,\text{Å} = 1 \times 10^{-15}$ fm.
   - D $1\,\text{Å} = 1 \times 10^{3}$ fm.
3. La velocità di $1{,}00 \times 10^2$ m/s espressa in km/h è:
   - A 36 km/h.
   - B 360 km/h.
   - C $27{,}8$ km/h.
   - D $3{,}60 \times 10^8$ km/h.
4. In fisica nucleare si usa l'angstrom (simbolo: $1\,\text{Å} = 1 \times 10^{-10}$ m) e il fermi o femtometro ($1\,\text{fm} = 1 \times 10^{-15}$ m). Qual è la relazione tra queste due unità di misura?
   - A $1\,\text{Å} = 1 \times 10^{5}$ fm.
   - B $1\,\text{Å} = 1 \times 10^{-5}$ fm.
   - C $1\,\text{Å} = 1 \times 10^{-15}$ fm.
   - D $1\,\text{Å} = 1 \times 10^{3}$ fm.

1. B
2. A
3. B
4. A

Example 2

Adapted from the response given by Florent Rougon in Multiple choice questions with proposed answers in random order — addition of automatic correction (cross mark). Source file.

1. La velocità di $1{,}00 \times 10^2$ m/s espressa in km/h è:
   - A 36 km/h.
   - ✓ B 360 km/h.
   - C $27{,}8$ km/h.
   - D $3{,}60 \times 10^8$ km/h.
2. In fisica nucleare si usa l'angstrom (simbolo: $1\,\text{Å} = 1 \times 10^{-10}$ m) e il fermi o femtometro ($1\,\text{fm} = 1 \times 10^{-15}$ m). Qual è la relazione tra queste due unità di misura?
   - ✓ A $1\,\text{Å} = 1 \times 10^{5}$ fm.
   - B $1\,\text{Å} = 1 \times 10^{-5}$ fm.
   - C $1\,\text{Å} = 1 \times 10^{-15}$ fm.
   - D $1\,\text{Å} = 1 \times 10^{3}$ fm.
3. La velocità di $1{,}00 \times 10^2$ m/s espressa in km/h è:
   - A 36 km/h.
   - ✓ B 360 km/h.
   - C $27{,}8$ km/h.
   - D $3{,}60 \times 10^8$ km/h.
4. In fisica nucleare si usa l'angstrom (simbolo: $1\,\text{Å} = 1 \times 10^{-10}$ m) e il fermi o femtometro ($1\,\text{fm} = 1 \times 10^{-15}$ m). Qual è la relazione tra queste due unità di misura?
   - ✓ A $1\,\text{Å} = 1 \times 10^{5}$ fm.
   - B $1\,\text{Å} = 1 \times 10^{-5}$ fm.
   - C $1\,\text{Å} = 1 \times 10^{-15}$ fm.
   - D $1\,\text{Å} = 1 \times 10^{3}$ fm.

1. B ※
2. A ※
3. B ※
4. A ※

Example 3

A *"simple multiple choice"* test. Source file.

1. First type of questions
   - A value
   - B correct
   - C value
   - D value
2. Second type of questions

   I. $2\alpha + 2\delta = 90^\circ$

   II. $\alpha = \delta$

   III. $\angle EDF = 45^\circ$

[1] The cool TEX automation tool: https://www.ctan.org/pkg/arara

(A) I only
(B) II only
(C) I and II only
(D) I and III only
(E) I, II, and III

3. Third type of questions
   (1) $2\alpha + 2\delta = 90^\circ$
   (2) $\angle EDF = 45^\circ$

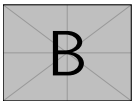
(A) value
(B) value
(C) value
(D) value
(E) value

4. Question with image and label below:



(A) (B) (C) (D) (E)

5. Question with image on right side:



(A) value
(B) value
(C) value
(D) correct
(E) value

Test keys

1. B, $x = 5$ ※
2. D ※
3. C, some note ※
4. E, A duck ※
5. D, other note ※

Example 4

A *"simple worksheet"* using ducks :) Source file.

Factor $x^2 - 2x + 1$

Factor $3x + 3y + 3z$

The following questions need to be quantified :)

True False
(a) $\alpha > \delta$
(b) LaTeX2e is cool?

Related to Linux
(a) You use Linux?
(b) Usually uses the package manager?
(c) Rate the following package and class
   i. `xsim-exam`
   ii. `xsim`
   iii. `exsheets`

The answer to 1 is $(x-1)^2$ and the answer to 3.(a) is False.

1. $(x-1)^2$ ※
2. $3(x+y+z)$ ※
3. (a) False ※
   (b) Very True! ※
4. (a) Yes ※
   (b) Yes, `dnf` ※
   (c) i. doesn't exist for now :(※
   ii. very good ※
   iii. obsolete ※

Example 5

Adapted from the response given by Stephen in SAT like question format. Source file.

1

Which choice best describes what happens in the passage?

A) One character argues with another character who intrudes on her home.
B) One character receives a surprising request from another character.
C) One character reminisces about choices she has made over the years.
D) One character criticizes another character for pursuing an unexpected course of action.

2

Which choice best describes what happens in the passage?

A) One character argues with another character who intrudes on her home.
B) One character receives a surprising request from another character.
C) One character reminisces about choices she has made over the years.
D) One character criticizes another character for pursuing an unexpected course of action.

3

Which choice best describes what happens in the passage?

A) One character argues with another character who intrudes on her home.
B) One character receives a surprising request from another character.
C) One character reminisces about choices she has made over the years.
D) One character criticizes another character for pursuing an unexpected course of action.

4

Which choice best describes what happens in the passage?

A) One character argues with another character who intrudes on her home.
B) One character receives a surprising request from another character.
C) One character reminisces about choices she has made over the years.
D) One character criticizes another character for pursuing an unexpected course of action.

1. A) 2. C) 3. B) 4. D)

Example 6

Adapted from the response to Environment for enumerate environment. Source file.

8.5a, KSC **10.** sample

A sample
✓ **B** answer
C sample
D sample

9.5a, KSC **11.** sample

A sample
B sample
C sample
✓ **D** answer

12. sample

A sample
B answer
C sample
D sample

13. sample

A sample
B sample
C sample
D answer

10. B (8.5a, KSC)
11. D (9.5a, KSC)
12. B (10.5a, KSC)
13. D (11.5a, KSC)

8 Tagged PDF examples

This section is just to show the compatibility of enumext with *tagged* PDF using `lualatex`. The files described below are just for testing and are intended as examples and, in a way, to simplify the time of Matthew Bertucci (`@mbertucci`) when he sees this excellent package and adds it to The LaTeX Tagged PDF repository.

To compile the tests with `lualatex-dev` the packages `multicol`, `unicode-math`, `geometry`, `graphicx`, `luamml` and `hyperref` are required along with the line:

```
\DocumentMetadata{lang = en-US, pdfversion = 2.0, pdfstandard = ua-2, tagging=on,}
```

All examples have been checked using `veraPDF` together with `ngpdf`.

- The file `enumext-01.tex` contains the basic tests for the `enumext` and `enumext*` environments and the nesting between them plus the use of the `label`, `labelwidth`, `labelsep`, `ref`, `align` and `wrap-label` keys. Source file and *tagged* PDF.
- The file `enumext-02.tex` contains the tests for the `enumext` and `enumext*` environments and the support for `minipage` and `multicols` environments using the keys `columns`, `columns-sep`, `mini-env`, `mini-right` and `\miniright` command. Source file and *tagged* PDF.
- The file `enumext-03.tex` contains the tests for the `enumext` and `keyanspic` environments activated by the `save-ans` key together with the `save-sep` and `save-ref` keys and the `\printkeyans` command. Source file and *tagged* PDF.

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- The file enumext-04.tex contains the tests for the \anskey command and the anskey* environment activated by the save-ans key along with the \getkeyans and \printkeyans commands. Source file and *tagged* PDF.
- The file enumext-05.tex contains the tests for the environments keyans, keyans* and keyanspic activated by the key save-ans together with the keys no-store and show-ans and the commands \setenumext, \setenumextmeta, \printkeyans and \foreachkeyans. Source file and *tagged* PDF.
- The file enumext-06.tex contains the tests for the environments enumext and enumext* for *fake* itemize and description. Source file and *tagged* PDF.
- The file enumext-07.tex contains the tests for starting the environments with \setenumext{resume}, the \resetenumext command and the series, resume, resume* and reset keys. Source file and *tagged* PDF.

9 The way of non-enumerated lists

It is possible to use (or abuse) the enumext and enumext* environments to mimic *non-enumerated* list environments such as itemize and description, clearly the ⟨*keys*⟩ to *"store answers"*, the keyans, keyans* and keyanspic environments lose their sense and it is not the focus of enumext package, but, why not to do it?.

Other uses of the enumext environment that can be helpful for specific purposes are shown as examples. The *trick* to generate these *"fake environments"* is to set label={} or label={⟨*some*⟩} and play with the list-indent, list-offset, font and wrap-label keys.

With *tagged* PDF a list whose label does not use the counter of the level is declared as *unordered*, as it happens in itemize. It is not declared as *description*, so the *fake* description environments are also *unordered*.

Fake itemize environment

The label key is set here using the default settings in LaTeX for the four levels \textbullet, \textendash, \textasteriskcentered and \textperiodcentered together with the nosep key to reduce the vertical spaces in the left side example and set the label key in *mathematical mode* for the right side as \ast, \diamond, \circ and \star for the four levels together with the nosep key

- First level item
  - Second level item
    - Third level item
      - Fourth level item
- First level item

∗ First level item
  ◇ Second level item
    ◦ Third level item
      ⋆ Fourth level item
∗ First level item

Fake description environment

Here label={} and list-indent=2.5em,font=\bfseries are set.

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short *one-line* description text.
Something long A much *longer* description text may take more than one line or more than one paragraph. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

Adding list-indent=0pt gives the *widest style*:

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short *one-line* description text.
Something long A much *longer* description text may take more than one line or more than one paragraph. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

The small space at the beginning of the *"unlabeled entry"* corresponds to \labelsep and can be removed using \hspace{-\labelsep} at the beginning of the line.

When *tagged* PDF is active \makelabel is redefined using \makebox for the align key. The width of this box is the larger of \labelwidth and the natural width of the label, so \item[⟨*content*⟩] wider than \labelwidth pushes the text to the right as in the default description style and there are no overlaps.

Description indented by label

Here label={} is set and a convenient value is given to labelsep and labelwidth, for example taking the *longest label* as reference and passing it as value using:

```
\newlength{\descitemwd}
\settowidth{\descitemwd}{\textbf{Something long}}
```

and then use `labelsep=4pt,labelwidth=\descitemwd,font=\bfseries`.

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short one-line description.
Something long A much longer description. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.

The environment can be translated so that the ⟨*labels*⟩ are on the left margin calculating the value passed to the `list-offset` key, in this case it will be equal to the sum of the values set by the `labelwidth` and `labelsep` keys finally resulting as `list-offset={-\descitemwd - 4pt}`.

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short one-line description.
Something long A much longer description. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.

Adding `align=right` gives:

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short one-line description.
Something long A much longer description. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.

At this point `list-offset={-\descitemwd - 4pt}` instead of `list-offset={-\labelwidth - \labelsep}`, this is because the parameters `\labelwidth` and `\labelsep` take the default values, as if `label` had not been set.

Description with multi-line labels

The `label` key does not accept *multiline material*, this is where the `wrap-label` and `wrap-label*` keys comes into play. Unlike the `enumitem` package, the `align` key only supports three options, so a command is created in the style `\parleft` of `enumitem` that allows placing *multiline labels* using `\parbox`.

```
\NewDocumentCommand \labelbx { s +m }
  {%
    \SuspendTagging{\parbox}%
    \IfBooleanTF{#1}
      {\strut\smash{\parbox[t]{\labelwidth}{\noindent\raggedright{#2}}}}%
      {\strut\smash{\parbox[t]{\labelwidth}{\noindent\raggedleft{#2}}}}%
    \ResumeTagging{\parbox}%
  }
```

Now it is only necessary to set `wrap-label*={\labelbx{#1}}`.

SomeThing A short one-line description.
This is an entry *without* a label.
Something A short one-line description.
Something long A much longer description. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.
SoMeThInG LoNg A much longer description. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris.

Final notes

The original implementation (if you can call it that) of the ideas that led to the creation of enumext were some macros using the `enumerate`[12] package for personal use created in early 2003, the code was quite questionable, but functional for these simple requirements.

With the great answers given by Christian Hupfer in Create a fake label ref using list and the answer given by David Carlisle in Change the use of label ref by data save in an array (list) I managed to create a more solid code than the original version, now using the `l3prop`[13] and `l3seq`[13] modules together with the `hyperref`[10] and `enumitem`[5] packages, which did the job, but with some shortcomings.

As time went by I took these shortcomings as a personal challenge which I called *"reinventing the wheel"*, since there were packages and classes that did more or less what I was looking for, but did not fit my simple requirements. This *"reinventing the wheel"* finally ended up becoming enumext.

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Why list environments?

The answer is simple, first I love the beauty of its syntax and many of what I had already written used the `enumerate` environment or lists created using the `enumitem` package. In my mind I thought: how complicated could it be to write a package that looked like `enumitem`? It seemed simple enough, of course I didn't have in mind the mess I was getting into working with `list` environments, `minipage` and adding support for the `multicol` and `hyperref` packages.

Of course, seeing the final result of the experiment *"reinventing the wheel"* I am quite satisfied.

Why not random questions and other utilities

The *"random"* type questions I love and hate them at the same time, although they simplify a lot the work when creating a multiple choice test, but you lose the beauty of typesetting a document with LaTeX, that is to say the output does not always look as nice as it should, even if they are only alternatives these must follow a certain order when presented either numerical or presentation, that said handling that using *nested lists* is quite complicated so I do not classify to be implemented.

Why has it taken so long?

One of the setbacks, beyond my laziness, was including compatibility with *tagged* PDF. To be honest, it's something I never considered at any point, but I firmly believe that being able to create *accessible documents* provides a great opportunity in the world of mathematics education. From my perspective as a *high school* teacher, beyond theorems and deep mathematics, the use of exercise lists is one of the most common things. Being able to open the way to work in parallel with those who have different abilities is really important and I regret not having looked into this in the past. I hope that enumext serves this purpose and inspires more users and authors to follow this path.

Regression tests

The source repository includes a set of regression tests for `l3build`, kept in the `testfiles` directory. They are run with the LuaTeX engine and the development format `latex-dev`, and each test is compiled twice so that references and labels are resolved before the log is compared:

- `test-001` and `test-002`: lists without tagging, with the labels, the spacing, the nesting, the counters, the series and `enumext*`, and the independence between `\setenumext` and `\printkeyans`;
- `test-003`: the keys that set vertical and horizontal spaces, penalties, the symbol of `\item*`, the code keys `before`, `first` and `after`, and the `minipage` keys;
- `test-004`: the storage system with `\anskey`, `anskey*`, `\printkeyans`, `\getkeyans` and `\foreachkeyans`, and the keys that store and show the answers;
- `test-005`: the environments `keyans`, `keyans*` and `keyanspic`, their keys and the standard lists nested in the options of `keyans*`;
- `test-006`: the exact vertical spaces above, below and beside the `minipage` and `multicols` variants (`mini-env`, `mini-right`, `\miniright` and `multicols`) in `enumext`, `enumext*`, `keyans` and `keyans*`, measured with boxes, and the closing of the `minipage` when the content ends in a character;
- `test-010` and `test-011`: the same lists and the storage system with `tagging=on`, including the structure tree and the standard lists and the environments based on `trivlist` nested in the content of an item of `enumext*`;
- `test-012`: the structure tree with `tagging=on` of the `minipage` and `multicols` variants, where the position of the figures records the vertical spaces;
- `test-013`: the `base-fix` key, with the baseline of the nested list measured with boxes for different values of `parsep`, `itemsep` and `columns`;
- `test-014`: the vertical spaces of the environment `keyanspic` with the label below and above the figures, measured with boxes for the keys `layout-top`, `layout-sep` and `label-sep`;
- `test-015`: the standard lists (`itemize`, `enumerate` and `description`) nested in the content of an item of `enumext*`, measured with boxes for different values of `columns`, `item-break` and joined items;
- `test-016`: the values of `labelwidth` and `labelsep` inside the nested lists, and the environments `quote`, `quotation`, `verse`, `list`, `center`, `trivlist`, `tabbing`, `verbatim` and the theorems nested in the content of an item of `enumext*`, measured with boxes;
- `test-017` and `test-018`: the `\footnote` command in `enumext`, `enumext*` and `keyans*` with `tagging=on`, with and without the `footnotehyper` package, where the structure tree must be the same in both cases;

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- `test-019`: the visible vertical spaces of the environment `keyanspic` with the font sizes 10pt, 11pt and 12pt, measured between the boxes of the PDF, for the keys `layout-top`, `layout-sep` and `label-sep`;
- `test-100`: the error and warning messages of the package.

From the root of the repository, `l3build check` runs all the tests and `l3build check test-001` runs a single one. After a deliberate change in the package, `l3build save test-001` regenerates the reference file `test-001.tlg`, which must be reviewed before committing it. The target `l3build testSE` compiles twice the documents in `sources/test-pkg`, validates the tagged structure and copies the PDF files that are attached to this manual; it is also run by `l3build release`.

10 References

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11 Change history

v2.6 (ctan), 2026-11-24
- When hyperref is loaded the save-ref key creates the link target with \MakeLinkTarget and the label with \label.
- *Tagged* PDF: the lists whose label does not use the counter, for example label={} or label={⟨\textbullet⟩}, are now declared as *unordered* lists instead of *ordered* lists.
- *Tagged* PDF: in enumext and keyans a label wider than \labelwidth pushes the text instead of overlapping it, and tall labels (images, tikz pictures) are no longer smashed and increase the height of the line again.
- The documentation is now a *tagged* PDF (PDF/UA-2).

v2.5 (ctan), 2026-11-14
- Support for footnotehyper v2.0 with *tagged* PDF: if it is loaded, it manages the \footnote in the environments.
- The keyanspic environment now adds the vertical space calculated with the real dimensions: layout-top, layout-sep and label-sep give the exact distance with any font size, and by default the space above and below is the same as in keyans. The default value of label-sep is 1pt above and 5pt below.
- Fixed the tagpdf error for \footnote in enumext* and keyans* with *tagged* PDF when footnotehyper is not loaded.

v2.4 (ctan), 2026-11-01
- New key item-break for enumext* and keyans*: an item that occupies the whole row is typeset without minipage and can be broken between pages.
- The standard lists and the environments quote, quotation, verse, center, tabbing, verbatim, those created with \newtheorem and similar ones can be used in the items of enumext* and keyans*.
- Fixed the duplicate error messages when the save-ans key is missing, the behavior of \setenumext with invalid levels and its interaction with \printkeyans, and widest for the labels \Roman* and \roman*.
- Fixed \miniright and mini-env, mini-right and mini-right*: spurious errors, exact vertical spaces and the end of the minipage. Fixed base-fix with parsep, itemsep and columns.
- Tagged PDF: balanced paragraph hooks, TextAlign attribute in item-break, and the minipage on the right side no longer leaves the tagging state active.
- Error and information messages with a common layout.
- Added regression tests, run with l3build check.

v2.3 (ctan), 2026-10-23
- Update requirement to LaTeX release 2026-11-01.
- Cleanup warnings and details returned by expltools.
- Replace \exp_after:wN by \exp_after:w.
- Update code for *tagged* PDF.
- Adjustments in the documentation.

v2.2 (ctan), 2026-06-01
- Update requirement to LaTeX release 2026-06-01.
- Move \setcounter to \begin{list}{⟨*arg one*⟩}{⟨*arg two*⟩\setcounter} for enumext*.
- Adjustments in the documentation.

v2.1 (ctan), 2026-01-15
- Fixed bad interaction between \setenumext and the ref key.

v2.0 (ctan), 2025-12-02
- Update requirement to multicol release 2025-10-21.
- Adjustments in the documentation.

v1.9 (ctan), 2025-11-01
- Update requirement to LaTeX release 2025-11-01.
- Move \setcounter to \begin{list}{⟨*arg one*⟩}{⟨*arg two*⟩\setcounter}.
- Update code for *tagged* PDF.

v1.8 (ctan), 2025-10-04
- Replacing \scantokens (primitive) with \tl_retokenize:n.
- Cleanup warnings and details returned by expltools.

v1.7 (ctan), 2025-07-10
- Fixed \setenumext{enumext*}{resume}.
- Fixed bad interaction between \setenumext and the resume key.
- The behavior of the key resume* has been updated and documented.

v1.6 (ctan), 2025-07-04
- Syntax simplification for \setenumextmeta.
- Environments can be started with the key resume *without value*.
- Add \resetenumext, reset and reset* keys.
- The resume, resume* and series keys can now be set per level.
- Fixed bad interaction between \printkeyans and the resume, resume* keys.

v1.5 (ctan), 2025-06-11
- Replacing \regex_match: (deprecated) with \regex_if_match:.
- Add keys beginpenalty, midpenalty and endpenalty.

v1.4 (ctan), 2025-06-09
- Improved implementation of the start key for *tagged* PDF.
- Improved implementation of the ref key.
- Fixed the behavior of the save-sep key.
- Fixed the behavior of the resume* key.

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v1.3 (ctan), 2025-06-01
- Removed dependency on the `scontents` package.
- The `anskey*` environment has been rewritten using the new `c-type` argument.

v1.2 (ctan), 2025-03-28
- Replace signature (prevent expansion for optional argument).
- Solve Inconsistent local/global assignment.

v1.1 (ctan), 2024-11-14
- Fixed implementation for `font` and `base-fix` keys.
- Added new keys for symbol marks.
- Update and improvements in the internal code.
- Adjustments in the documentation.

v1.0 (ctan), 2024-11-01
- First public release.

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13 Implementation

The most recent publicly released version of enumext is available at CTAN: https://www.ctan.org/pkg/enumext. While general feedback via email is welcomed, specific bugs or feature requests should be reported through the issue tracker: https://github.com/pablgonz/enumext/issues.

The documentation presented here is far from professional, it contains a lot of obvious information that to the eye of a TEXpert are superfluous, but, after so many years developing this project is the only way to remember what does what.

13.1 General conventions

Variables containing i, ii, iii and iv are associated by level with the enumext environment, variables containing v are associated with the keyans environment, variables containing vi are associated with the keyanspic environment, variables containing vii are associated with the enumext* environment and variables containing viii are associated with the keyans* environment.

To simplify writing and documentation some variables and functions that are common to the different levels of the environments are described using a capital "X".

The temporary function __enumext_tmp:n is used in different parts of the package code for variable creation or execution of other functions that are grouped into this one.

All variables and functions defined in this package are private and are NOT intended to work or be used by another package or module.

13.2 Initial set up

Start the DocStrip guards.

```
⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention) for l3doc class.

```
⟨@@=enumext⟩
```

13.3 Declaration of the package

Checks for a minimum release version of LaTeX; otherwise it returns an "error".

```
\NeedsTeXFormat{LaTeX2e}[2026-11-01]
\IfFormatAtLeastF { 2026-11-01 }
  {
    \PackageError { enumext }
      { LaTeX~kernel~too~old~need~2026-11-01~or~later }
      {
        enumext~requires~a~LaTeX2e~release~2026-11-01~or~
        later.~Update~your~TeX~distribution.
      }
  }
```

Now declare the enumext package.

```
\ProvidesExplPackage {enumext} {2026-11-24} {2.6} {Enumerate exercise sheets}
```

Finally, check if the multicol package is loaded; if not, it is loaded.

```
\hook_gput_code:nnn {begindocument} {enumext}
  {
    \IfPackageLoadedTF { multicol }
      {
        \msg_info:nnn { enumext } { package-load } { multicol }
      }
      {
        \msg_info:nnn { enumext } { package-not-load } { multicol }
        \RequirePackage{multicol}[2025-10-21]
      }
  }
```

13.4 Definition of variables

This section describes the variables shared by several commands, keys or environments, in groups and by purpose. The variables that belong to a single command, key or environment are defined in the subsection where they are used, in the part *"Definition of variables"*. The variables that do not appear in either place are created by means of \keys_define:nn or some function described below.

13.4.1 Nesting levels and state of the environments

\l__enumext_level_int
\l__enumext_level_h_int
\l__enumext_keyans_level_int
\l__enumext_keyans_level_h_int
\l__enumext_keyans_pic_level_int

Integer variables will control the nesting levels of the environments.

```
\int_new:N \l__enumext_level_int
\int_new:N \l__enumext_level_h_int
\int_new:N \l__enumext_keyans_level_int
\int_new:N \l__enumext_keyans_level_h_int
\int_new:N \l__enumext_keyans_pic_level_int
```

(*End of definition for* `\l__enumext_level_int` *and others.*)

\l__enumext_starred_bool
\g__enumext_starred_bool
\l__enumext_starred_first_bool
\l__enumext_standard_bool
\g__enumext_standard_bool
\l__enumext_standard_first_bool
\l__enumext_keyans_env_bool
\g__enumext_start_line_tl
\g__enumext_envir_name_tl
\l__enumext_envir_name_tl

Internal variables used by functions `\__enumext_is_not_nested:`, `\__enumext_is_on_first_level:` and `\__enumext_keyans_name_and_start:` (§13.5.3).

```
\bool_new:N \l__enumext_starred_bool
\bool_new:N \g__enumext_starred_bool
\bool_new:N \l__enumext_starred_first_bool
\bool_new:N \l__enumext_standard_bool
\bool_new:N \g__enumext_standard_bool
\bool_new:N \l__enumext_standard_first_bool
\bool_new:N \l__enumext_keyans_env_bool
\tl_new:N   \g__enumext_start_line_tl
\tl_new:N   \g__enumext_envir_name_tl
\tl_new:N   \l__enumext_envir_name_tl
```

(*End of definition for* `\l__enumext_starred_bool` *and others.*)

13.4.2 Counters, labels and numbering

\l__enumext_current_widest_dim

The dimension `\l__enumext_current_widest_dim` stores the current label width. It is used by `widest` (§13.15) and `label` (§13.13) keys.

```
\dim_new:N \l__enumext_current_widest_dim
```

(*End of definition for* `\l__enumext_current_widest_dim`.)

\l__enumext_resume_count_bool
\l__enumext_resume_count_X_bool

Internal variables shared by the `start` and `start*` keys (§13.15), the `resume`, `resume*` and `series` keys (§13.27) and the environments.

```
\bool_new:N \l__enumext_resume_count_bool
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_resume_count_ #1 _bool }
  }
\clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_resume_count_bool` *and* `\l__enumext_resume_count_X_bool`.)

\l__enumext_start_X_int
\l__enumext_fake_item_indent_X_tl

The integer `\l__enumext_start_X_int` is used by the `start` and `start*` keys (§13.15) and the token list `\l__enumext_fake_item_indent_X_tl` is used by `itemindent` key (§13.19.1).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \int_new:c { l__enumext_start_ #1 _int           }
    \tl_new:c  { l__enumext_fake_item_indent_ #1 _tl }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_start_X_int` *and* `\l__enumext_fake_item_indent_X_tl`.)

\l__enumext_wrap_label_X_bool
\l__enumext_wrap_label_opt_X_bool
\l__enumext_label_fill_left_X_tl
\l__enumext_label_fill_right_X_tl
\l__enumext_align_label_pos_X_str

The bool vars `\l__enumext_wrap_label_X_bool` and `\l__enumext_wrap_label_opt_X_bool` are used by `wrap-label` and `wrap-label*` keys (§13.13). The variables `\l__enumext_label_fill_left_X_tl`, `\l__enumext_label_fill_right_X_tl` and `\l__enumext_align_label_pos_X_str` are used by the `align` key (§13.13).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_wrap_label_ #1 _bool     }
    \bool_new:c { l__enumext_wrap_label_opt_ #1 _bool }
    \tl_new:c   { l__enumext_label_fill_left_ #1 _tl  }
    \tl_new:c   { l__enumext_label_fill_right_ #1 _tl }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vii, viii } { \__enumext_tmp:n {#1} }
\cs_set_protected:Nn \__enumext_tmp:n
```

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```
  {
    \str_new:c { l__enumext_align_label_pos_ #1 _str }
  }
\clist_map_inline:nn { i, ii, iii, iv, v } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_wrap_label_X_bool` *and others.*)

13.4.3 Horizontal and vertical spaces

`\l__enumext_leftmargin_tmp_X_bool`
`\l__enumext_leftmargin_tmp_X_dim`
`\l__enumext_leftmargin_X_dim`

The key `list-indent` (§13.19) uses the boolean variable `\l__enumext_leftmargin_tmp_X_bool` and the dimension `\l__enumext_leftmargin_tmp_X_dim`. The dimension `\l__enumext_leftmargin_X_dim` is used and set by the function `\__enumext_calc_hspace:NNNNNNN` (§13.42.4).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_leftmargin_tmp_ #1 _bool }
    \dim_new:c  { l__enumext_leftmargin_tmp_ #1 _dim  }
    \dim_new:c  { l__enumext_leftmargin_ #1 _dim      }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vi, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_leftmargin_tmp_X_bool`, `\l__enumext_leftmargin_tmp_X_dim`, *and* `\l__enumext_leftmargin_X_dim`.)

`\l__enumext_multicols_above_X_skip`
`\l__enumext_multicols_below_X_skip`

Internal variables used by `columns` key (§13.24).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \skip_new:c { l__enumext_multicols_above_ #1 _skip }
    \skip_new:c { l__enumext_multicols_below_ #1 _skip }
  }
\clist_map_inline:nn { i, ii, iii, iv, v } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_multicols_above_X_skip` *and* `\l__enumext_multicols_below_X_skip`.)

`\g__enumext_minipage_stat_int`
`\g__enumext_minipage_right_skip`
`\l__enumext_minipage_left_X_dim`
`\l__enumext_minipage_active_X_bool`

Internal variables used by `\miniright` command (§13.25.7) and the keys `mini-right`, `mini-right*`, `mini-env` and `mini-sep` (§13.23, §13.25).

```
\int_new:N  \g__enumext_minipage_stat_int
\skip_new:N \g__enumext_minipage_right_skip
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \dim_new:c  { l__enumext_minipage_left_ #1 _dim    }
    \bool_new:c { l__enumext_minipage_active_ #1 _bool }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\g__enumext_minipage_stat_int` *and others.*)

`\l__enumext_item_starred_X_bool`
`\l__enumext_item_break_X_bool`
`\l__enumext_item_column_pos_X_int`
`\g__enumext_item_count_all_X_int`
`\l__enumext_item_text_X_box`
`\l__enumext_joined_width_X_dim`
`\g__enumext_item_symbol_aux_X_tl`
`\l__enumext_align_label_X_str`
`\g__enumext_minipage_center_X_bool`
`\g__enumext_minipage_right_X_dim`

Internal variables used by `enumext*` and `keyans*` environments. The key `item-break` (§13.21) sets the boolean `\l__enumext_item_break_X_bool`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_item_starred_ #1 _bool    }
    \bool_new:c { l__enumext_item_break_ #1 _bool      }
    \int_new:c  { l__enumext_item_column_pos_ #1 _int  }
    \int_new:c  { g__enumext_item_count_all_ #1 _int   }
    \box_new:c  { l__enumext_item_text_ #1 _box        }
    \dim_new:c  { l__enumext_joined_width_ #1 _dim     }
    \tl_new:c   { g__enumext_item_symbol_aux_ #1 _tl   }
    \str_new:c  { l__enumext_align_label_ #1 _str      }
    \bool_new:c { g__enumext_minipage_center_ #1 _bool }
    \dim_new:c  { g__enumext_minipage_right_ #1 _dim   }
  }
\clist_map_inline:nn { vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_item_starred_X_bool` *and others.*)

13.4.4 Storing answers, checking and printing

\l__enumext_store_active_bool
\l__enumext_store_name_tl
\g__enumext_store_name_tl
\l__enumext_store_current_label_tl
\l__enumext_store_current_opt_arg_tl

The variable \l__enumext_store_active_bool set by save-ans key (§13.30.3) activates all the mechanism related to \anskey, anskey*, keyans, keyans* and keyanspic environments.

The variable \l__enumext_store_name_tl saves the {⟨*store name*⟩} set by the save-ans key of the *sequence* and *prop list* where the content is stored. The variable \g__enumext_store_name_tl is just a global copy of {⟨*store name*⟩} used by different functions.

The *current label* and *optional argument* of \item* (§13.41) and \anspic* (§13.46.4) are saved in the variables \l__enumext_store_current_label_tl and \l__enumext_store_current_opt_arg_tl for the keyans, keyans* and keyanspic environments.

```
\bool_new:N \l__enumext_store_active_bool
\tl_new:N   \l__enumext_store_name_tl
\tl_new:N   \g__enumext_store_name_tl
\tl_new:N   \l__enumext_store_current_label_tl
\tl_new:N   \l__enumext_store_current_opt_arg_tl
```

(*End of definition for* \l__enumext_store_active_bool *and others.*)

\l__enumext_check_answers_bool
\g__enumext_check_ans_key_bool
\l__enumext_check_start_line_env_tl
\l__enumext_item_wrap_key_bool
\g__enumext_check_starred_cmd_int
\g__enumext_item_anskey_int
\g__enumext_item_number_int
\l__enumext_item_number_bool
\g__enumext_item_answer_diff_int

Internal variables used by *"internal check answer"* mechanism (§13.30.5) used by the check-ans, no-store, wrap-ans* keys and check for starred commands \item* in keyans and keyans* environments and \anspic* in keyanspic environment.

```
\bool_new:N \l__enumext_check_answers_bool
\bool_new:N \g__enumext_check_ans_key_bool
\tl_new:N   \l__enumext_check_start_line_env_tl
\bool_new:N \l__enumext_item_wrap_key_bool
\int_new:N  \g__enumext_check_starred_cmd_int
\int_new:N  \g__enumext_item_anskey_int
\int_new:N  \g__enumext_item_number_int
\bool_new:N \l__enumext_item_number_bool
\int_new:N  \g__enumext_item_answer_diff_int
```

(*End of definition for* \l__enumext_check_answers_bool *and others.*)

\l__enumext_print_keyans_star_bool
\l__enumext_print_keyans_cmd_bool
\l__enumext_print_keyans_X_tl
\l__enumext_mark_position_str
\l__enumext_mark_position_v_str
\l__enumext_mark_position_viii_str

The boolean \l__enumext_print_keyans_cmd_bool is true while the command \printkeyans (§13.51) is running and the environments consult it. The boolean \l__enumext_print_keyans_star_bool is true when the command receives the *starred* argument and the token lists \l__enumext_print_keyans_X_tl store the keys passed to each environment. The position of the marks set by the mark-pos key (§13.31) is stored in the strings \l__enumext_mark_position_str, \l__enumext_mark_position_v_str and \l__enumext_mark_position_viii_str.

```
\bool_new:N \l__enumext_print_keyans_star_bool
\bool_new:N \l__enumext_print_keyans_cmd_bool
\str_new:N  \l__enumext_mark_position_str
\str_new:N  \l__enumext_mark_position_v_str
\str_new:N  \l__enumext_mark_position_viii_str
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \tl_new:c { l__enumext_print_keyans_ #1 _tl }
  }
\clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* \l__enumext_print_keyans_star_bool *and others.*)

13.4.5 hyperref, labels and references

\l__enumext_hyperref_bool
\l__enumext_footnotes_key_bool
\l__enumext_footnotehyper_tag_bool

The boolean variable \l__enumext_hyperref_bool will determine if the hyperref package is present or loaded in memory (§13.7). The boolean variable \l__enumext_footnotes_key_bool determines if hyperref is loaded with the key hyperfootnotes=true. The boolean variable \l__enumext_footnotehyper_tag_bool determines if *tagged* PDF is active and the footnotehyper package, with support for it, is loaded.

```
\bool_new:N \l__enumext_hyperref_bool
\bool_new:N \l__enumext_footnotes_key_bool
\bool_new:N \l__enumext_footnotehyper_tag_bool
```

(*End of definition for* \l__enumext_hyperref_bool*,* \l__enumext_footnotes_key_bool*, and* \l__enumext_footnotehyper_tag_bool.)

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\l__enumext_newlabel_arg_one_tl
\l__enumext_newlabel_arg_two_tl
\l__enumext_write_aux_file_tl
\l__enumext_label_copy_X_tl

Internal variables used by save-ref key (§13.31). The variables \l__enumext_label_copy_X_tl correspond to temporary copies of the ⟨*labels*⟩ defined by level on which operations will be performed.

The variables \l__enumext_newlabel_arg_one_tl and \l__enumext_newlabel_arg_two_tl will be used to form the arguments passed to the function __enumext_newlabel:nn (§13.7) and the variable \l__enumext_write_aux_file_tl will be in charge of executing the writing code in the .aux file.

```
\tl_new:N \l__enumext_newlabel_arg_one_tl
\tl_new:N \l__enumext_newlabel_arg_two_tl
\tl_new:N \l__enumext_write_aux_file_tl
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \tl_new:c { l__enumext_label_copy_ #1 _tl }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vi, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* \l__enumext_newlabel_arg_one_tl *and others.*)

13.4.6 Constants

\c__enumext_all_envs_clist

An internal clist-var variable to run with __enumext_tmp:n.

```
\clist_const:Nn \c__enumext_all_envs_clist
  {
    {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv},
    {keyans}{v}, {enumext*}{vii}, {keyans*}{viii}
  }
```

(*End of definition for* \c__enumext_all_envs_clist.)

13.5 Some utility functions

13.5.1 Definition of messages for the internal hooks

These messages are not error messages, they only write information to the .log file with the standard layout of the information messages.

prop-seq-int-hook
item-answer-hook

Messages written to the .log file by the internal hooks that show the values of the global variables of the storage.

```
\msg_new:nnn { enumext } { prop-seq-int-hook }
  {
    Storage~'#1':~
    \c_backslash_str g__enumext_ #1 _prop~has~#2~elements,~
    \c_backslash_str g__enumext_ #1 _seq~has~#3~elements,~
    \c_backslash_str g__enumext_resume_ #1 _int~=~#4.
  }
\msg_new:nnn { enumext } { item-answer-hook }
  {
    Items~=~#1,~answers~=~#2,~difference~=~#3.
  }
```

(*End of definition for* prop-seq-int-hook *and* item-answer-hook.)

13.5.2 General utility functions

\keys_precompile:neN
\seq_use:NV
\keys_set:en
\keys_set:ev
\str_if_in:vnF

Non-standard kernel variants used by the \printkeyans command (§13.51) and \foreachkeyans command (§13.54), and by the functions that set the keys of each level.

```
\cs_generate_variant:Nn \keys_precompile:nnN { neN }
\cs_generate_variant:Nn \seq_use:Nn { NV }
\cs_generate_variant:Nn \keys_set:nn { en, ev }
\prg_generate_conditional_variant:Nnn \str_if_in:nn { v } { F }
```

(*End of definition for* \keys_precompile:neN *and others.*)

__enumext_at_begin_document:n

A internal *"hook"* function used for copying plain list and minipage environments definition and hyperref detection.

```
\cs_new_protected:Nn \__enumext_at_begin_document:n
  {
    \hook_gput_code:nnn {begindocument} {enumext} {#1}
  }
```

(*End of definition for* __enumext_at_begin_document:n.)

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__enumext_after_env:nn

An internal *"hook"* function to execute code `mini-right` and `mini-right*` keys outside the `enumext*` and `keyans*` environments and print `check-ans` outside the `enumext` and `enumext*` environments.

```
\cs_new_protected:Nn \__enumext_after_env:nn
  {
    \hook_gput_code:nnn {env/#1/after} {enumext} {#2}
  }
```

(*End of definition for* `\__enumext_after_env:nn`.)

__enumext_level:

Function for check current level in `enumext`.

```
\cs_new:Nn \__enumext_level:
  {
    \int_to_roman:n { \l__enumext_level_int }
  }
```

(*End of definition for* `\__enumext_level:`.)

__enumext_if_is_int:nT
__enumext_if_is_int:nF
__enumext_if_is_int:nTF

A conditional function to determine whether the variable being passed is an integer used by `start` and `widest` keys. This function is taken directly from the answer given by Henri Menke in How to test if an expl3 function argument is an integer expression?.

```
\prg_new_protected_conditional:Npnn \__enumext_if_is_int:n #1 { T, F, TF }
  {
    \regex_if_match:nnTF { ^[\+\-]?[\d]+$ } {#1} % $
      { \prg_return_true: }
      { \prg_return_false: }
  }
```

(*End of definition for* `\__enumext_if_is_int:nT`, `\__enumext_if_is_int:nF`, *and* `\__enumext_if_is_int:nTF`.)

__enumext_show_length:nnn

Internal function used by `show-length` key to show *"all lengths"* calculated and used in `enumext`, `enumext*`, `keyans` and `keyans*` environments.

```
\cs_new:Nn \__enumext_show_length:nnn
  {
    *~#2
    \prg_replicate:nn { 14 - \str_count:n {#2} } {~}
      =~\use:c { #1 _use:c } { l__enumext_ #2 _ #3 _ #1 } \\
  }
```

(*End of definition for* `\__enumext_show_length:nnn`.)

__enumext_unskip_unkern:

The function `\__enumext_unskip_unkern:` will remove the last ⟨*skip*⟩ or ⟨*kern*⟩ at execution time using the values `11` and `12` of `\lastnodetype` to apply `\unskip` or `\unkern` depending on the case. In the *outer* vertical mode TEX can't take things from the current page, because `\unskip` and `\unkern` are errors there, so a negative `\vskip` or `\kern` is used instead, as LATEX does in `\removelastskip`.

```
\cs_new_protected:Nn \__enumext_unskip_unkern:
  {
    \int_case:nn { \lastnodetype }
      {
        { 11 }
          {
            \mode_if_vertical:TF
              {
                \mode_if_inner:TF
                  { \unskip }
                  { \skip_vertical:n { -\lastskip } }
              }
              { \unskip }
          }
        { 12 }
          {
            \mode_if_vertical:TF
              {
                \mode_if_inner:TF
                  { \unkern }
                  { \kern -\lastkern \scan_stop: }
              }
              { \unkern }
          }
      }
  }
```

(*End of definition for* `\__enumext_unskip_unkern:`.)

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13.5.3 Utilities for environments and levels

__enumext_is_not_nested:
__enumext_is_on_first_level:

The function __enumext_is_not_nested: sets the variables \g__enumext_standard_bool and \g__enumext_starred_bool to true only if the environments enumext and enumext* are NOT nested in each other and saves the environment name in \l__enumext_envir_name_tl.

```
\cs_new_protected:Nn \__enumext_is_not_nested:
  {
    \str_case:en { \@currenvir }
      {
        {enumext}
          {
            \tl_set:Ne \l__enumext_envir_name_tl { enumext }
            \bool_lazy_and:nnT
              { \bool_not_p:n { \g__enumext_standard_bool } }
              { \int_compare_p:nNn { \l__enumext_level_h_int } = { 0 } }
              {
                \bool_gset_true:N \g__enumext_standard_bool
              }
          }
        {enumext*}
          {
            \tl_set:Ne \l__enumext_envir_name_tl { enumext* }
            \bool_lazy_and:nnT
              { \bool_not_p:n { \g__enumext_starred_bool } }
              { \int_compare_p:nNn { \l__enumext_level_int } = { 0 } }
              {
                \bool_gset_true:N \g__enumext_starred_bool
              }
          }
      }
  }
```

The function __enumext_is_on_first_level: sets the variables \l__enumext_standard_first_bool (§13.30.3), \l__enumext_starred_first_bool (§13.30.3) to true only if the environment is not nested and it is at the *"first level"*. They also save the *start line number* of each environment in the variable \g__enumext_start_line_tl and the *name* of each environment in the variable \g__enumext_envir_name_tl to use in messages related to the check-ans key and .log file.

```
\cs_new_protected:Nn \__enumext_is_on_first_level:
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \g__enumext_standard_bool }
        { \int_compare_p:nNn { \l__enumext_level_int } = { 1 } }
        { \int_compare_p:nNn { \l__enumext_level_h_int } = { 0 } }
      }
      {
        \bool_set_true:N \l__enumext_standard_first_bool
        \tl_gset:Nn \g__enumext_envir_name_tl { enumext }
        \tl_gset:Ne \g__enumext_start_line_tl
          {
            on~line~\exp_not:V \inputlineno
          }
      }
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \g__enumext_starred_bool }
        { \int_compare_p:nNn { \l__enumext_level_h_int } = { 1 } }
        { \int_compare_p:nNn { \l__enumext_level_int } = { 0 } }
      }
      {
        \bool_set_true:N \l__enumext_starred_first_bool
        \tl_gset:Nn \g__enumext_envir_name_tl { enumext* }
        \tl_gset:Ne \g__enumext_start_line_tl
          {
            on~line~\exp_not:V \inputlineno
          }
      }
  }
```

(*End of definition for* __enumext_is_not_nested: *and* __enumext_is_on_first_level:.)

__enumext_keyans_name_and_start:

The function __enumext_keyans_name_and_start: will save the start line number and name of the environments keyans, keyans* and keyanspic in the variables \l__enumext_check_start_line_env_tl and \l__enumext_envir_name_tl to use in the __enumext_check_starred_cmd:n function.

```
\cs_new_protected:Nn \__enumext_keyans_name_and_start:
  {
    \str_case:en { \@currenvir }
      {
        {keyans}
          {
            \tl_set:Ne \l__enumext_envir_name_tl { keyans }
            \tl_set:Ne \l__enumext_check_start_line_env_tl
              {
                in~'keyans'~start~on~line~\exp_not:V \inputlineno
              }
          }
        {keyans*}
          {
            \tl_set:Ne \l__enumext_envir_name_tl { keyans* }
            \tl_set:Ne \l__enumext_check_start_line_env_tl
              {
                in~'keyans*'~start~on~line~\exp_not:V \inputlineno
              }
          }
        {keyanspic}
          {
            \tl_set:Ne \l__enumext_envir_name_tl { keyanspic }
            \tl_set:Ne \l__enumext_check_start_line_env_tl
              {
                in~'keyanspic'~start~on~line~\exp_not:V \inputlineno
              }
          }
      }
  }
```

(*End of definition for* __enumext_keyans_name_and_start:.)

13.5.4 Utilities for log and terminal

__enumext_reset_global_vars:
__enumext_reset_global_int:
__enumext_reset_global_bool:
__enumext_reset_global_tl:

The function __enumext_reset_global_vars: will be passed to __enumext_execute_after_env: and will return the global variables to their default values after being used.

```
\cs_new_protected:Nn \__enumext_reset_global_vars:
  {
    \__enumext_reset_global_int:
    \__enumext_reset_global_bool:
    \__enumext_reset_global_tl:
  }
\cs_new_protected:Nn \__enumext_reset_global_int:
  {
    \int_gzero:N \g__enumext_item_number_int
    \int_gzero:N \g__enumext_item_anskey_int
    \int_gzero:N \g__enumext_item_answer_diff_int
  }
\cs_new_protected:Nn \__enumext_reset_global_bool:
  {
    \bool_gset_false:N \g__enumext_check_ans_key_bool
    \bool_gset_false:N \g__enumext_standard_bool
    \bool_gset_false:N \g__enumext_starred_bool
  }
\cs_new_protected:Nn \__enumext_reset_global_tl:
  {
    \tl_gclear:N \g__enumext_store_name_tl
    \tl_gclear:N \g__enumext_start_line_tl
    \tl_gclear:N \g__enumext_envir_name_tl
  }
```

(*End of definition for* __enumext_reset_global_vars: *and others.*)

__enumext_log_global_vars:
__enumext_log_answer_vars:

The function __enumext_log_global_vars: will be passed to __enumext_execute_after_env: and write to the .log file the number of elements saved in the *prop list* and *sequence* created by the save-ans key along with the value of the integer variable created for the resume key.

```
\cs_new_protected:Nn \__enumext_log_global_vars:
```

```
  {
    \msg_info:nneeee { enumext } { prop-seq-int-hook }
      { \g__enumext_store_name_tl }
      { \prop_count:c { g__enumext_ \g__enumext_store_name_tl _prop } }
      { \seq_count:c { g__enumext_ \g__enumext_store_name_tl _seq } }
      { \int_use:c { g__enumext_resume_ \g__enumext_store_name_tl _int } }
  }
```

The function `\__enumext_log_answer_vars:` will be passed to `\__enumext_execute_after_env:` and write to the `.log` file the number of items and answers along with the difference between them.

```
\cs_new_protected:Nn \__enumext_log_answer_vars:
  {
    \msg_info:nneee { enumext } { item-answer-hook }
      { \int_use:N \g__enumext_item_number_int }
      { \int_use:N \g__enumext_item_anskey_int }
      { \int_eval:n { \g__enumext_item_number_int - \g__enumext_item_anskey_int} }
  }
```

(*End of definition for* `\__enumext_log_global_vars:` *and* `\__enumext_log_answer_vars:`.)

13.6 Copying `list` and `minipage` environments

The `list` environment provided by LaTeX has the following plain form[14]:

```
\list{⟨arg one⟩}{⟨arg two⟩}
  \item[⟨opt⟩]
\endlist
```

And `minipage` environment provided by LaTeX has the following (simplified) plain form:

```
\minipage[⟨pos⟩][⟨height⟩][⟨inner-pos⟩]{⟨width⟩}
  ⟨internal implement⟩
\endminipage
```

As a precaution they are copied using `\__enumext_at_begin_document:n` in case any package redefines the `list` environment or a related command.

For compatibility with *tagged* PDF, `\NewCommandCopy` should be used and not `\cs_new_eq:NN` for `\item`. When *tagged* PDF is active `\item` is redefined using `ltcmd` (see `latex-lab-block`[15]).

`\__enumext_start_list:nn`
`\__enumext_stop_list:`
`\__enumext_item_std:w`
`\__enumext_minipage:w`
`\__enumext_endminipage:`

The functions `\__enumext_start_list:nn` and `\__enumext_stop_list:` correspond to copies of `\list` and `\endlist` from plain definition of `list` environment, the function `\__enumext_item_std:w` is a copy of the `\item` command.

```
\__enumext_at_begin_document:n
  {
    \cs_new_eq:NN   \__enumext_start_list:nn \list
    \cs_new_eq:NN   \__enumext_stop_list: \endlist
    \NewCommandCopy \__enumext_item_std:w \item
  }
```

The functions `\__enumext_minipage:w` and `\__enumext_endminipage:` correspond to copies of `\minipage` and `\endminipage` from plain definition of `minipage` environment.

```
\__enumext_at_begin_document:n
  {
    \cs_new_eq:NN \__enumext_minipage:w \minipage
    \cs_new_eq:NN \__enumext_endminipage: \endminipage
  }
```

(*End of definition for* `\__enumext_start_list:nn` *and others.*)

13.7 Compatibility with hyperref and footnotehyper

`\__enumext_after_hyperref:`

First, the necessary rules are defined using *"hooks"* to determine if the `hyperref` package is loaded.

```
\hook_gput_code:nnn { begindocument } { enumext } { \__enumext_after_hyperref: }
\hook_gset_rule:nnnn { begindocument } { enumext } { after } { hyperref }
```

The function `\__enumext_after_hyperref:` sets the boolean variable `\l__enumext_hyperref_bool` to `true` if the package is loaded. The public macro `\IfHyperBoolean` determines if the `hyperfootnotes=true` key is present, and if so, the boolean variable `\l__enumext_footnotes_key_bool` is set to `true`.

```
\cs_new_protected:Nn \__enumext_after_hyperref:
```

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```
  {
    \IfPackageLoadedT { hyperref }
      {
        \msg_info:nnn { enumext } { package-load } { hyperref }
        \bool_set_true:N \l__enumext_hyperref_bool
        \IfHyperBoolean{hyperfootnotes}
          {
            \bool_set_true:N \l__enumext_footnotes_key_bool
          }
          { }
      }
```

If the variable `\l__enumext_footnotes_key_bool` is true, it checks whether the package `footnotehyper` is loaded; if it is not, `\l__enumext_footnotes_key_bool` is set to false and `\footnote` is redefined. When *tagged* PDF is active and the package `footnotehyper` is loaded in version 2.0 (2026/11/12) or later, which supports it, the boolean variable `\l__enumext_footnotehyper_tag_bool` is set to `true` and `\footnote` is not redefined.

```
\bool_if:NT \l__enumext_footnotes_key_bool
  {
    \IfPackageLoadedTF { footnotehyper }
      {
        \msg_info:nnn { enumext } { package-load } { footnotehyper }
      }
      {
        \bool_set_false:N \l__enumext_footnotes_key_bool
      }
  }
\IfDocumentMetadataT
  {
    \IfPackageAtLeastT { footnotehyper } { 2026/11/12 }
      {
        \bool_set_true:N \l__enumext_footnotehyper_tag_bool
      }
  }
  }
```

(*End of definition for* `\__enumext_after_hyperref:`.)

`\__enumext_newlabel:nn`

The function `\__enumext_newlabel:nn` writes the information to the `.aux` file when using the `save-ref` key. The arguments taken by the function are:

```
#1 : \l__enumext_newlabel_arg_one_tl
#2 : \l__enumext_newlabel_arg_two_tl
```

If the `hyperref` package is loaded the link target is created with `\MakeLinkTarget*` and the label with `\label`, which writes the `\newlabel` with the page, the *name* and the *anchor*, using the `\@currentlabel` and `\@currentlabelname` set here to `\l__enumext_newlabel_arg_two_tl`. Without the package a plain `\newlabel{#1}{#2}` is written, since `\label` adds spaces that would change the typeset boxes.

```
\cs_new_protected:Nn \__enumext_newlabel:nn
  {
    \bool_if:NTF \l__enumext_hyperref_bool
      {
        \group_begin:
          \tl_set:Nn \@currentlabel {#2}
          \tl_set:Nn \@currentlabelname {#2}
          \MakeLinkTarget* {#1}
          \label {#1}
        \group_end:
      }
      {
        \protected@write \@auxout { }
          { \token_to_str:N \newlabel {#1} { {#2} { } } }
      }
  }
```

(*End of definition for* `\__enumext_newlabel:nn`.)

13.8 Internal redefining `\footnote` command

To keep the correct numbering of `\footnote` and to make it work correctly in the `enumext*` and `keyans*` environments and `mini-env` key it is necessary to redefine the `\footnote` command. This implementation is adapted from the answer given by Clea F. Rees (`@cfr`) in footnotes in boxes compatible with hyperref.

\g__enumext_footnote_standard_int
\g__enumext_footnote_starred_int
\g__enumext_footnote_standard_arg_seq
\g__enumext_footnote_starred_arg_seq
\g__enumext_footnote_standard_int_seq
\g__enumext_footnote_starred_int_seq
\g__enumext_footnote_box
\l__enumext_footnote_wd_dim

Internal variables used for redefinition of \footnote (§13.8).

```
\int_new:N \g__enumext_footnote_standard_int
\int_new:N \g__enumext_footnote_starred_int
\seq_new:N \g__enumext_footnote_standard_arg_seq
\seq_new:N \g__enumext_footnote_starred_arg_seq
\seq_new:N \g__enumext_footnote_standard_int_seq
\seq_new:N \g__enumext_footnote_starred_int_seq
```

(*End of definition for* \g__enumext_footnote_standard_int *and others.*)

__enumext_footnotetext:nn
__enumext_renew_footnote:
__enumext_print_footnote:
__enumext_renew_footnote_mini:
__enumext_print_footnote_mini:
__enumext_renew_footnote_mini_tagged:
__enumext_print_footnote_mini_tagged:

Redefinition of the \footnote command using \footnotetext and \footnotemark for the mini-env key in the enumext and keyans environments.

```
\cs_new_protected:Nn \__enumext_footnotetext:nn
  {
    \footnotetext[#1]{#2}
  }
\cs_new_protected:Nn \__enumext_renew_footnote:
  {
    \RenewDocumentCommand \footnote { o +m }
      {
        \tl_if_novalue:nTF {##1}
          {
            \stepcounter{footnote}
            \int_gset_eq:Nc \g__enumext_footnote_standard_int { c@footnote }
          }
          {
            \int_gset:Nn \g__enumext_footnote_standard_int {##1}
          }
        \footnotemark [ \g__enumext_footnote_standard_int ]
        \seq_gput_right:Nn \g__enumext_footnote_standard_arg_seq {##2}
        \seq_gput_right:NV
          \g__enumext_footnote_standard_int_seq \g__enumext_footnote_standard_int
      }
  }
\cs_new_protected:Nn \__enumext_print_footnote:
  {
    \seq_if_empty:NF \g__enumext_footnote_standard_int_seq
      {
        \seq_map_pairwise_function:NNN
          \g__enumext_footnote_standard_int_seq
          \g__enumext_footnote_standard_arg_seq
          \__enumext_footnotetext:nn
      }
    \seq_gclear:N \g__enumext_footnote_standard_arg_seq
    \seq_gclear:N \g__enumext_footnote_standard_int_seq
  }
```

The enumext* and keyans* environments are implemented using minipage, so \footnote must also be redefined to keep this numbering as if it were part of the document.

```
\cs_new_protected:Nn \__enumext_renew_footnote_mini:
  {
    \RenewDocumentCommand \footnote { o +m }
      {
        \tl_if_novalue:nTF {##1}
          {
            \stepcounter{footnote}
            \int_gset_eq:Nc \g__enumext_footnote_starred_int { c@footnote }
          }
          {
            \int_gset:Nn \g__enumext_footnote_starred_int {##1}
          }
        \footnotemark [ \g__enumext_footnote_starred_int ]
        \seq_gput_right:Nn \g__enumext_footnote_starred_arg_seq {##2}
        \seq_gput_right:NV
          \g__enumext_footnote_starred_int_seq \g__enumext_footnote_starred_int
      }
  }
\cs_new_protected:Nn \__enumext_print_footnote_mini:
  {
    \seq_if_empty:NF \g__enumext_footnote_starred_int_seq
```

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```
      {
        \seq_map_pairwise_function:NNN
          \g__enumext_footnote_starred_int_seq
          \g__enumext_footnote_starred_arg_seq
          \__enumext_footnotetext:nn
      }
    \seq_gclear:N \g__enumext_footnote_starred_arg_seq
    \seq_gclear:N \g__enumext_footnote_starred_int_seq
  }
```

With *tagged* PDF, a `\footnotetext` placed after a list gives a `tagpdf` error (see `tagging-project` issue 1337), so in the `enumext*` and `keyans*` environments the notes are processed inside the item, as the `footnotehyper` package does. The plug `enumextsave` of the socket `fntext/process` saves the note in the box `\g__enumext_footnote_box` instead of inserting it, with the width stored in `\l__enumext_footnote_wd_dim`.

```
\box_new:N \g__enumext_footnote_box
\dim_new:N \l__enumext_footnote_wd_dim
\IfDocumentMetadataT
  {
    \NewSocketPlug { fntext/process } { enumextsave }
      {
        \vbox_gset:Nn \g__enumext_footnote_box
          {
            \vbox_unpack_drop:N \g__enumext_footnote_box
            \dim_set_eq:NN \columnwidth \l__enumext_footnote_wd_dim
            #1
          }
      }
  }
```

The function `\__enumext_renew_footnote_mini_tagged:` redefines `\footnote` to use that plug in a group, with the counter and the mark of the document (not those of the `minipage`), and `\__enumext_print_footnote_mini_tagged:` delivers the saved notes after the environment with the default plug of the socket.

```
\cs_new_protected:Nn \__enumext_renew_footnote_mini_tagged:
  {
    \dim_set_eq:NN \l__enumext_footnote_wd_dim \columnwidth
    \RenewDocumentCommand \footnote { o +m }
      {
        \tl_if_novalue:nTF {##1}
          {
            \stepcounter{footnote}
            \int_gset_eq:Nc \g__enumext_footnote_starred_int { c@footnote }
          }
          {
            \int_gset:Nn \g__enumext_footnote_starred_int {##1}
          }
        \footnotemark [ \g__enumext_footnote_starred_int ]
        \group_begin:
          \cs_set:Npn \@mpfn { footnote }
          \cs_set_eq:NN \thempfn \thefootnote
          \cs_set_eq:NN \@footnotetext \fnote_footnotetext:n
          \AssignSocketPlug { fntext/process } { enumextsave }
          \footnotetext [ \g__enumext_footnote_starred_int ] {##2}
        \group_end:
      }
  }
\cs_new_protected:Nn \__enumext_print_footnote_mini_tagged:
  {
    \box_if_empty:NF \g__enumext_footnote_box
      {
        \socket_use:nn { fntext/process }
          {
            \reset@font
            \footnotesize
            \int_set_eq:NN \interlinepenalty \interfootnotelinepenalty
            \skip_set:Nn \splittopskip { \footnotesep }
            \dim_set:Nn \splitmaxdepth { \box_dp:N \strutbox }
            \int_set_eq:NN \floatingpenalty \@MM
            \vbox_unpack_drop:N \g__enumext_footnote_box
```

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```
            }
        }
    }
```

(*End of definition for* `\__enumext_footnotetext:nn` *and others.*)

`\__enumext_renew_footnote_standard:`
`\__enumext_print_footnote_standard:`
`\__enumext_renew_footnote_starred:`
`\__enumext_print_footnote_starred:`

The redefinition of `\footnote` is encapsulated to pass it to the internal `\__enumext_mini_page` environment used by the `mini-env` key in the `enumext` and `keyans` environments. It is executed when the `footnotehyper` package does not manage the notes: when it is not loaded or, with *tagged* PDF active, when its version does not support it. In this last case the notes of the `enumext*` and `keyans*` environments are printed with `\__enumext_print_footnote_mini_tagged:`.

```
\cs_new_protected:Nn \__enumext_renew_footnote_standard:
  {
    \bool_if:NT \g__enumext_standard_bool
      {
        \IfDocumentMetadataTF
          {
            \bool_if:NF \l__enumext_footnotehyper_tag_bool
              {
                \__enumext_renew_footnote:
              }
          }
          {
            \bool_if:NF \l__enumext_footnotes_key_bool
              {
                \__enumext_renew_footnote:
              }
          }
      }
  }
\cs_new_protected:Nn \__enumext_print_footnote_standard:
  {
    \bool_if:NT \g__enumext_standard_bool
      {
        \IfDocumentMetadataTF
          {
            \bool_if:NF \l__enumext_footnotehyper_tag_bool
              {
                \__enumext_print_footnote:
              }
          }
          {
            \bool_if:NF \l__enumext_footnotes_key_bool
              {
                \__enumext_print_footnote:
              }
          }
      }
  }
```

The redefinition of `\footnote` is encapsulated to pass it to the `enumext*` and `keyans*` environments. It is executed under the same conditions.

```
\cs_new_protected:Nn \__enumext_renew_footnote_starred:
  {
    \IfDocumentMetadataTF
      {
        \bool_if:NF \l__enumext_footnotehyper_tag_bool
          {
            \__enumext_renew_footnote_mini_tagged:
          }
      }
      {
        \bool_if:NF \l__enumext_footnotes_key_bool
          {
            \__enumext_renew_footnote_mini:
          }
      }
  }
\cs_new_protected:Nn \__enumext_print_footnote_starred:
  {
```

```
    \IfDocumentMetadataTF
      {
        \bool_if:NF \l__enumext_footnotehyper_tag_bool
          {
            \__enumext_print_footnote_mini_tagged:
          }
      }
      {
        \bool_if:NF \l__enumext_footnotes_key_bool
          {
            \__enumext_print_footnote_mini:
          }
      }
  }
```

In enumext* and keyans* environments it is necessary to use *"hooks"* to print \footnote with support for *tagged* PDF when the redefinition above is used.

```
\__enumext_after_env:nn { enumext* }
  {
    \__enumext_print_footnote_starred:
  }
\__enumext_after_env:nn { keyans* }
  {
    \__enumext_print_footnote_starred:
  }
```

(*End of definition for* __enumext_renew_footnote_standard: *and others.*)

13.9 The internal minipage environment

__enumext_internal_mini_page:
__enumext_mini_page

The function __enumext_internal_mini_page: creates an internal __enumext_mini_page environment (*custom version* of minipage) setting the \if@minipage switch to false to allow spaces at the *"above"* of the environment, plus \skip_vertical:N \c_zero_skip is added to maintain alignment on *"top"* in the first part and \skip_vertical:N \c_zero_skip in the second part to allow spaces *"below"*. This environment will be used internally by the mini-env key, it is NOT documented in the user interface and is for internal use only. Within this environment \footnote is redefined to make the notes look the same as if they were elsewhere in the document. This implementation is adapted from the answer given by Max Chernoff (@MaxChernoff) in Customize minipage to support spaces below it.

This function is passed to the function __enumext_safe_exec: in the enumext environment definition (§13.43) and __enumext_safe_exec_vii: in the enumext* environment definition (§13.48).

```
\cs_new_protected:Nn \__enumext_internal_mini_page:
  {
    \int_compare:nNnT { \l__enumext_level_int } = { 0 }
      {
        \DeclareDocumentEnvironment{__enumext_mini_page}{ m }
          {
            \__enumext_renew_footnote_standard:
            \__enumext_minipage:w [ t ] {##1}
              \legacy_if_gset_false:n { @minipage }
              \skip_vertical:N \c_zero_skip
          }
          {
              \skip_vertical:N \c_zero_skip
            \__enumext_endminipage:
            \__enumext_print_footnote_standard:
          }
      }
  }
```

(*End of definition for* __enumext_internal_mini_page: *and* __enumext_mini_page.)

13.10 Definition of public dimension

The package enumext only provides a single public dimension \itemwidth and is intended for user convenience only and is not for internal use as such. This dimension is set in all environments and is only used by the wrap-ans key at its default value.

```
\dim_zero_new:N \itemwidth
```

13.11 Definition of counters

13.11.1 Definition of variables

\l__enumext_counter_i_tl
\l__enumext_counter_ii_tl
\l__enumext_counter_iii_tl
\l__enumext_counter_iv_tl
\l__enumext_counter_v_tl
\l__enumext_counter_vi_tl
\l__enumext_counter_vii_tl
\l__enumext_counter_viii_tl

Variables to store the *"name of the counters"* enumXi, enumXii, enumXiii and enumXiv for enumext environment, enumXv for keyans environment and enumXvi for the keyanspic environment. The counters enumXvii and enumXviii are used by enumext* and keyans* environments.

The initial values of these variables are set by the function __enumext_define_counter:Nn (§13.11) and then modified by the function __enumext_label_style:Nnn used by label key (§13.14).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \tl_new:c { l__enumext_counter_ #1 _tl }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vi, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* \l__enumext_counter_i_tl *and others.*)

13.11.2 Definition of error messages

counters

Message used in the creation of counters by enumext package.

```
\msg_new:nnnn { enumext } { counters }
  {
    The~counter~'#1'~is~already~defined~by~some~package~or~macro,~
    it~cannot~be~continued.
  }
  {
    Another~package~or~macro~already~defines~the~counter~'#1'.~
    Check~for~a~conflict~with~'enumext'.
  }
```

(*End of definition for* counters.)

13.11.3 Internal functions for the counters

__enumext_define_counter:Nn
enumXi
enumXii
enumXiii
enumXiv
enumXv
enumXvi
enumXvii
enumXviii

To create the necessary *"counters"*, the function first checks that they are not already defined by the user or a package such as enumitem; otherwise it returns an error and aborts the package loading. The arguments taken by the function are:

#1 : A token list \l__enumext_counter_X_tl to *"store"* the counter's name.
#2 : The counter's name.

```
\cs_new_protected:Nn \__enumext_define_counter:Nn
  {
    \cs_if_exist:cTF { c@ #2 }
      { \msg_fatal:nnn { enumext } { counters }{#2} }
      {
        \tl_set:Nn #1 {#2}
        \newcounter {#2}
      }
  }
```

The counters created here are enumXi, enumXii, enumXiii and enumXiv for enumext environment, enumXv for keyans environment, enumXvi for keyanspic environment, enumXvii for enumext* and enumXviii for the keyans* environments.

```
\__enumext_define_counter:Nn \l__enumext_counter_i_tl    { enumXi    }
\__enumext_define_counter:Nn \l__enumext_counter_ii_tl   { enumXii   }
\__enumext_define_counter:Nn \l__enumext_counter_iii_tl  { enumXiii  }
\__enumext_define_counter:Nn \l__enumext_counter_iv_tl   { enumXiv   }
\__enumext_define_counter:Nn \l__enumext_counter_v_tl    { enumXv    }
\__enumext_define_counter:Nn \l__enumext_counter_vi_tl   { enumXvi   }
\__enumext_define_counter:Nn \l__enumext_counter_vii_tl  { enumXvii  }
\__enumext_define_counter:Nn \l__enumext_counter_viii_tl { enumXviii }
```

(*End of definition for* __enumext_define_counter:Nn *and others.*)

\c@__enumext_resume_i_int
\c@__enumext_resume_ii_int
\c@__enumext_resume_iii_int
\c@__enumext_resume_iv_int
\c@__enumext_resume_vii_int

In version 1.6 the command \resetenumext (§13.28) was added which internally uses \counterwithin* so for its correct operation, *"real counters"* are created instead of the *"integer variables"* for the keys resume and resume*.

```
\cs_set_protected:Nn \__enumext_tmp:n
```

```
643   {
644     \cs_if_exist:cTF { c@ __enumext_resume_ #1 _int }
645       { \msg_fatal:nne { enumext } { counters }{ __enumext_resume_ #1 _int } }
646       {
647         \newcounter { __enumext_resume_ #1 _int }
648       }
649   }
650 \clist_map_inline:nn {i,ii,iii,iv,vii} { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\c@__enumext_resume_i_int` *and others.*)

13.12 Definition of labels

This part of the code is inspired by the `enumitem` package. The idea is to be able to access the counters using `\arabic*`, `\Alph*`, `\alph*`, `\Roman*` and `\roman*` to use them in the `label` key.

Direct support for this is provided since LaTeX release 2025-06-01[11], but the original implementation is kept so as not to hinder the internal *"label and ref"* system.

`\g__enumext_counter_styles_tl` `\g__enumext_widest_label_tl` `\l__enumext_label_width_by_box`

The variable `\g__enumext_counter_styles_tl` stores the default ⟨*label style*⟩ and the variable `\g__enumext_widest_label_tl` the label width. The box `\l__enumext_label_width_by_box` is used by the function `\__enumext_label_width_by_box:Nn` to measure the width of a label. These variables are used by `widest` (§13.15) and `label` (§13.13) keys.

```
651 \tl_new:N  \g__enumext_counter_styles_tl
652 \tl_new:N  \g__enumext_widest_label_tl
653 \box_new:N \l__enumext_label_width_by_box
```

(*End of definition for* `\g__enumext_counter_styles_tl`, `\g__enumext_widest_label_tl`, *and* `\l__enumext_label_width_by_box`.)

`\__enumext_register_default_label_wd:Nn`

These ⟨*counters*⟩ will be used as default ⟨*labels*⟩ if the `label` key is not used for the different levels of the `enumext`, `enumext*`, `keyans` and `keyans*` environments, so it is necessary to get a default value for `labelwidth` from these ⟨*labels*⟩ at the same time.

```
654 \cs_new_protected:Nn \__enumext_register_default_label_wd:Nn
655   {
656     \tl_const:cn { c__enumext_widest_ \cs_to_str:N #1 _tl } {#2}
657     \tl_gput_right:Nn \g__enumext_counter_styles_tl {#1}
658   }
659 \__enumext_register_default_label_wd:Nn \arabic { 0 }
660 \__enumext_register_default_label_wd:Nn \Alph   { M }
661 \__enumext_register_default_label_wd:Nn \alph   { m }
662 \__enumext_register_default_label_wd:Nn \Roman  { VIII }
663 \__enumext_register_default_label_wd:Nn \roman  { viii }
```

(*End of definition for* `\__enumext_register_default_label_wd:Nn`.)

`\__enumext_label_width_by_box:Nn` `\__enumext_label_width_by_box:cv`

The function `\__enumext_label_width_by_box:Nn` sets the default `\labelwidth` using a box width if no `labelwidth` key is passed.

```
664 \cs_new_protected:Nn \__enumext_label_width_by_box:Nn
665   {
666     \hbox_set:Nn \l__enumext_label_width_by_box {#2}
667     \dim_set:Nn #1 { \box_wd:N \l__enumext_label_width_by_box }
668   }
669 \cs_generate_variant:Nn \__enumext_label_width_by_box:Nn { cv }
```

(*End of definition for* `\__enumext_label_width_by_box:Nn`.)

`\__enumext_label_style:Nnn` `\__enumext_label_style:cvn`

The function `\__enumext_label_style:Nnn` is used by the `label` key to create the variables containing the ⟨*label style*⟩ and allows using `\arabic*`, `\Alph*`, `\alph*`, `\Roman*` and `\roman*` as arguments.

It loops through the defined counter styles in `\g__enumext_counter_styles_tl` (`\arabic`, `\alph`, `\Alph`, `\roman` and `\Roman`) for example, looking for `\roman*` and replacing that by `\roman{`⟨*counter*⟩`}`, and doing the same for the `\g__enumext_widest_label_tl` to keep both in sync.

```
670 \cs_new_protected:Nn \__enumext_label_style:Nnn
671   {
672     \tl_clear_new:N #1
673     \tl_put_right:Ne #1 { \tl_trim_spaces:n {#3} }
674     \tl_gset_eq:NN \g__enumext_widest_label_tl #1
675     \tl_map_inline:Nn \g__enumext_counter_styles_tl
676       {
```

```
677         \tl_replace_all:Nne #1 { ##1* } { \exp_not:N ##1 {#2} }
678         \tl_greplace_all:Nne \g__enumext_widest_label_tl { ##1* }
679           { \tl_use:c { c__enumext_widest_ \cs_to_str:N ##1 _tl } }
680       }
681     \__enumext_label_width_by_box:Nn \l__enumext_current_widest_dim
682       { \tl_use:N \g__enumext_widest_label_tl }
683     \tl_set_eq:cN { the #2 } #1
684   }
685 \cs_generate_variant:Nn \__enumext_label_style:Nnn { cvn }
```

(*End of definition for* `\__enumext_label_style:Nnn`.)

13.13 Setting keys associated with label

When *tagged* PDF is active `\makelabel` is redefined using `\makebox` to work correctly (§13.38). From the user side it is convenient to have a key that allows using this redefinition with `\makebox` without having `\IfDocumentMetadataTF` active.

mode-box Defines the key `mode-box` only for the *"first level"* of `enumext` and `enumext*` environments.

```
686 \cs_set_protected:Nn \__enumext_tmp:n
687   {
688     \keys_define:nn { enumext /  #1 }
689       {
690         mode-box .bool_set:N = \l__enumext_mode_box_bool,
691         mode-box .initial:n = false,
692         mode-box .value_forbidden:n = true,
693       }
694   }
695 \clist_map_inline:nn { level-1, enumext* } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `mode-box`.)

font, labelsep, labelwidth, wrap-label, wrap-label* Definition of keys `font`, `labelsep`, `labelwidth`, `wrap-label` and `wrap-label*` keys for `enumext` and `keyans` environments.

```
696 \cs_set_protected:Nn \__enumext_tmp:nn
697   {
698     \keys_define:nn { enumext / #1 }
699       {
700         font        .tl_set:c = { l__enumext_label_font_style_ #2 _tl },
701         font        .value_required:n = true,
702         labelsep    .dim_set:c = { l__enumext_labelsep_ #2 _dim },
703         labelsep    .initial:n = {0.3333em},
704         labelsep    .value_required:n = true,
705         labelwidth  .dim_set:c = { l__enumext_labelwidth_ #2 _dim },
706         labelwidth  .value_required:n = true,
707         wrap-label  .cs_set_protected:cp = { __enumext_wrapper_label_ #2 :n } ##1,
708         wrap-label  .initial:n = {##1},
709         wrap-label  .value_required:n = true,
710         wrap-label* .code:n =
711           {
712             \bool_set_true:c { l__enumext_wrap_label_opt_ #2 _bool }
713             \keys_set:nn { enumext / #1 } { wrap-label = {##1} }
714           },
715         wrap-label* .value_required:n = true,
716       }
717   }
718 \clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* `font` *and others.*)

align The `align` key is implemented differently for *"starred"* and *"non starred"* environments. For compatibility with *tagged* PDF it is necessary to set `\l__enumext_align_label_pos_X_str`.

```
719 \cs_set_protected:Nn \__enumext_tmp:nn
720   {
721     \keys_define:nn { enumext / #1 }
722       {
723         align .choices:nn =
724           { left , right , center }
725           {
726             \int_case:nn { \l_keys_choice_int }
```

```
727                {
728                  {1}
729                    {
730                      \tl_clear:c { l__enumext_label_fill_left_ #2 _tl  }
731                      \tl_set:cn  { l__enumext_label_fill_right_ #2 _tl } { \hfill }
732                      \str_set:cn { l__enumext_align_label_pos_ #2 _str } { l }
733                    }
734                  {2}
735                    {
736                      \tl_set:cn  { l__enumext_label_fill_left_ #2 _tl  } { \hfill }
737                      \tl_clear:c { l__enumext_label_fill_right_ #2 _tl }
738                      \str_set:cn { l__enumext_align_label_pos_ #2 _str } { r }
739                    }
740                  {3}
741                    {
742                      \tl_set:cn { l__enumext_label_fill_left_ #2 _tl  } { \hfill }
743                      \tl_set:cn { l__enumext_label_fill_right_ #2 _tl } { \hfill }
744                      \str_set:cn { l__enumext_align_label_pos_ #2 _str } { c }
745                    }
746                }
747            },
748          align .initial:n = left,
749          align .value_required:n = true,
750          align / unknown .code:n =
751            \msg_error:nneee { enumext } { unknown-choice }
752              { align } { left,~right,~ center } { \exp_not:n {##1} },
753        }
754    }
755  \clist_map_inline:nn
756    {
757      {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv}, {keyans}{v}
758    }
759    { \__enumext_tmp:nn #1 }

760  \cs_set_protected:Nn \__enumext_tmp:nn
761    {
762      \keys_define:nn { enumext / #1 }
763        {
764          align .choices:nn =
765            { left , right , center }
766            {
767              \int_case:nn { \l_keys_choice_int }
768                {
769                  {1} { \str_set:cn { l__enumext_align_label_ #2 _str } { l } }
770                  {2} { \str_set:cn { l__enumext_align_label_ #2 _str } { r } }
771                  {3} { \str_set:cn { l__enumext_align_label_ #2 _str } { c } }
772                }
773            },
774          align .initial:n = left,
775          align .value_required:n = true,
776          align / unknown .code:n =
777            \msg_error:nneee { enumext } { unknown-choice }
778              { align } { left,~right,~ center } { \exp_not:n {##1} },
779        }
780    }
781  \clist_map_inline:nn { {enumext*}{vii}, {keyans*}{viii} } { \__enumext_tmp:nn #1 }
```

(*End of definition for* `align`.)

13.14 Setting `label` and `ref` keys

The implementation of the keys `label` and `ref` are part of the core of the package enumext, here the default values for ⟨*label*⟩, the value of the variables `\l__enumext_label_X_tl`, the default values for `\labelwidth` and the *"label and ref"* system.

13.14.1 Definition of variables

`\l__enumext_ref_key_arg_tl`
`\l__enumext_ref_the_count_tl`
`\l__enumext_renew_counter_X_tl`
`\l__enumext_the_counter_X_tl`

Internal variables used by `ref` key (§13.14).

```
782  \tl_new:N \l__enumext_ref_key_arg_tl
783  \tl_new:N \l__enumext_ref_the_count_tl
784  \cs_set_protected:Nn \__enumext_tmp:n
785    {
```

```
    \tl_new:c  { l__enumext_renew_counter_ #1 _tl }
    \tl_new:c  { l__enumext_the_counter_ #1 _tl   }
    \tl_set:ce { l__enumext_the_counter_ #1 _tl   } { \exp_not:c { theenumX #1 } }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vi, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_ref_key_arg_tl` *and others.*)

13.14.2 Definition of error messages

key-ref-empty

Messages used by `ref` key.

```
\msg_new:nnnn { enumext } { key-ref-empty }
  {
    Key~'ref'~needs~a~value~in~'#1'~\msg_line_context:.
  }
  {
    Give~a~value~to~the~key~'ref'~or~remove~it.
  }
```

(*End of definition for* `key-ref-empty`.)

13.14.3 Define and set `label` and `ref` keys for `enumext` environment

label
ref
\l__enumext_label_i_tl
\l__enumext_label_ii_tl
\l__enumext_label_iii_tl
\l__enumext_label_iv_tl

Sets the default ⟨*labels*⟩ of the *four levels* of `enumext` environment, along with the default values for `labelwidth`, `widest` and `ref` keys.

```
\cs_set_protected:Nn \__enumext_tmp:nnn
  {
    \tl_const:cn { c__enumext_default_label_ #2 _tl } {#3}
    \keys_define:nn { enumext / #1 }
      {
        label .code:n =
          {
            \__enumext_label_style:cvn { l__enumext_label_ #2 _tl }
              { l__enumext_counter_ #2 _tl } {##1}
            \dim_set_eq:cN  { l__enumext_labelwidth_ #2 _dim }
              \l__enumext_current_widest_dim
          },
        label .initial:n = #3,
        label .value_required:n = true,
        ref   .code:n = { \__enumext_standard_ref:nn {#2} {##1} },
        ref   .value_required:n = true,
      }
  }
\__enumext_tmp:nnn { level-1 } {   i } { \arabic*.}
\__enumext_tmp:nnn { level-2 } {  ii } { (\alph*) }
\__enumext_tmp:nnn { level-3 } { iii } { \roman*. }
\__enumext_tmp:nnn { level-4 } {  iv } { \Alph*.  }
```

(*End of definition for* `label` *and others.*)

__enumext_standard_ref:nn
__enumext_standard_ref:

The `\__enumext_standard_ref:nn` function will first pass the key *argument* `ref` to the variable `\l__enumext_ref_key_arg_tl` and analyze its state, if it is not *empty* it will set a copy of the *current counter style* saved in `\l__enumext_the_counter_X_tl` to `\l__enumext_ref_the_count_tl` and then set the variable `\l__enumext_renew_counter_X_tl` which will modify `\theenumX`.

```
\cs_new_protected:Nn \__enumext_standard_ref:nn
  {
    \tl_set:Nn \l__enumext_ref_key_arg_tl {#2}
    \tl_if_empty:NTF \l__enumext_ref_key_arg_tl
      {
        \msg_error:nnn { enumext } { key-ref-empty } { enumext }
      }
      {
        \tl_set_eq:Nc \l__enumext_ref_the_count_tl { l__enumext_the_counter_ #1 _tl }
        \tl_set:ce { l__enumext_renew_counter_ #1 _tl }
          {
            \exp_not:N \renewcommand { \exp_not:V \l__enumext_ref_the_count_tl }
              { \exp_not:V \l__enumext_ref_key_arg_tl }
          }
      }
  }
```

Finally the function `\__enumext_standard_ref:` will execute the modification for the reference system in the second argument of the environment definition `enumext`.

```
\cs_new_protected:Nn \__enumext_standard_ref:
  {
    \tl_if_empty:cF { l__enumext_renew_counter_ \__enumext_level: _tl }
      {
        \tl_use:c { l__enumext_renew_counter_ \__enumext_level: _tl }
      }
  }
```

(*End of definition for* `\__enumext_standard_ref:nn` *and* `\__enumext_standard_ref:`.)

13.14.4 Define and set `label` and `ref` keys for `enumext*` and `keyans*` environments

`label` `ref` `\l__enumext_label_vii_tl` `\l__enumext_label_viii_tl`

Sets the default ⟨*labels*⟩ for `enumext*` and `keyans*` environments, along with the default value for `labelwidth` key and `ref` key.

```
\cs_set_protected:Nn \__enumext_tmp:nnn
  {
    \tl_const:cn { c__enumext_default_label_ #2 _tl } {#3}
    \keys_define:nn { enumext / #1 }
      {
        label .code:n =
          {
            \__enumext_label_style:cvn { l__enumext_label_ #2 _tl }
              { l__enumext_counter_ #2 _tl } {##1}
            \dim_set_eq:cN  { l__enumext_labelwidth_ #2 _dim }
                \l__enumext_current_widest_dim
          },
        label .initial:n = #3,
        label .value_required:n = true,
        ref   .code:n = { \__enumext_starred_ref:n {##1} },
        ref   .value_required:n = true,
      }
  }
\__enumext_tmp:nnn { enumext* } {  vii } { \arabic*.}
\__enumext_tmp:nnn { keyans*  } { viii } { \Alph*) }
```

(*End of definition for* `label` *and others.*)

`\__enumext_starred_ref:n` `\__enumext_starred_ref:`

The implementation of `\__enumext_starred_ref:n` is the same as that used for the environment `enumext`.

```
\cs_new_protected:Nn \__enumext_starred_ref:n
  {
    \tl_set:Nn \l__enumext_ref_key_arg_tl {#1}
    \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
      {
        \tl_if_empty:NTF \l__enumext_ref_key_arg_tl
          {
            \msg_error:nnn { enumext } { key-ref-empty } { enumext* }
          }
          {
            \tl_set_eq:NN \l__enumext_ref_the_count_tl \l__enumext_the_counter_vii_tl
            \tl_set:Ne \l__enumext_renew_counter_vii_tl
              {
                \exp_not:N \renewcommand { \exp_not:V \l__enumext_ref_the_count_tl }
                  { \exp_not:V \l__enumext_ref_key_arg_tl }
              }
          }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \tl_if_empty:NTF \l__enumext_ref_key_arg_tl
          {
            \msg_error:nnn { enumext } { key-ref-empty } { keyans* }
          }
          {
            \tl_set_eq:NN \l__enumext_ref_the_count_tl \l__enumext_the_counter_viii_tl
            \tl_set:Ne \l__enumext_renew_counter_viii_tl
              {
                \exp_not:N \renewcommand  { \exp_not:V \l__enumext_ref_the_count_tl }
                  { \exp_not:V \l__enumext_ref_key_arg_tl }
```

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```
            }
        }
    }
}
```

Finally the function `\__enumext_starred_ref:` will execute the modification for the reference system in the second argument of the `enumext*` and `keyans*` environment definition.

```
\cs_new_protected:Nn \__enumext_starred_ref:
  {
    \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
      {
        \tl_if_empty:NF \l__enumext_renew_counter_vii_tl
          {
            \tl_use:N \l__enumext_renew_counter_vii_tl
          }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \tl_if_empty:NF \l__enumext_renew_counter_viii_tl
          {
            \tl_use:N \l__enumext_renew_counter_viii_tl
          }
      }
  }
```

(*End of definition for* `\__enumext_starred_ref:n` *and* `\__enumext_starred_ref:`.)

13.14.5 Define and set `label` and `ref` keys for `keyans` and `keyanspic` environments

`label`
`ref`
`\l__enumext_label_v_tl`
`\l__enumext_label_vi_tl`

Sets the default ⟨*label*⟩ for `keyans` and `keyanspic` environment, along with the default value for `labelwidth` if it has not been established and `ref` key. The `keyanspic` environment use the same ⟨*label*⟩ as the `keyans` environment.

```
\keys_define:nn { enumext / keyans }
  {
    label .code:n =
      {
        \__enumext_label_style:cvn { l__enumext_label_v_tl }
          { l__enumext_counter_v_tl } {#1}
        \__enumext_label_style:cvn { l__enumext_label_vi_tl }
          { l__enumext_counter_vi_tl } {#1}
        \dim_set_eq:NN
          \l__enumext_labelwidth_v_dim \l__enumext_current_widest_dim
      },
    label .initial:n = \Alph*),
    label .value_required:n = true,
    ref   .code:n = { \__enumext_keyans_ref:n {#1} },
    ref   .value_required:n = true,
  }
```

(*End of definition for* `label` *and others.*)

`\__enumext_keyans_ref:n`
`\__enumext_keyans_ref:`

The implementation of `\__enumext_keyans_ref:n` is the same as that used for the environment `enumext`.

```
\cs_new_protected:Nn \__enumext_keyans_ref:n
  {
    \tl_set:Nn \l__enumext_ref_key_arg_tl {#1}
    \tl_if_empty:NTF \l__enumext_ref_key_arg_tl
      {
        \msg_error:nnn { enumext } { key-ref-empty } { keyans }
      }
      {
        \tl_set_eq:NN \l__enumext_ref_the_count_tl \l__enumext_the_counter_v_tl
        \tl_put_right:Ne \l__enumext_renew_counter_v_tl
          {
            \exp_not:N \renewcommand { \exp_not:V \l__enumext_ref_the_count_tl }
              { \exp_not:V \l__enumext_ref_key_arg_tl }
          }
      }
  }
```

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Finally the function __enumext_keyans_ref: will execute the modification for the reference system in the second argument of the keyans environment definition.

```
\cs_new_protected:Nn \__enumext_keyans_ref:
  {
    \tl_if_empty:NF \l__enumext_renew_counter_v_tl
      {
        \tl_use:N \l__enumext_renew_counter_v_tl
      }
  }
```

(*End of definition for* __enumext_keyans_ref:n *and* __enumext_keyans_ref:.)

13.15 Setting start, start* and widest keys

__enumext_start_from:NNn
__enumext_start_from:ccn
__enumext_start_from:cce

The function __enumext_start_from:NNn used by start and start* keys takes three arguments:

#1 : \l__enumext_label_X_tl
#2 : \l__enumext_start_X_int
#3 : ⟨*integer or string*⟩

The argument '#1' is the *"counter style"* set by label key, '#2' is returned by the function, '#3' can be an ⟨*integer*⟩ or ⟨*string*⟩ of the form \Alph, \alph, \Roman or \roman. This effectively allows start*=A or start=1 to be used.

In version 1.6 it is allowed to pass the resume key *without value* by means of the command \setenumext, for the correct operation of this, the boolean variable \l__enumext_resume_count_bool set by the resume key *without value* must be set to false (§13.27). This is necessary to be able to "reset" the *start value* by means of the start or start* keys.

```
\cs_new_protected:Nn \__enumext_start_from:NNn
  {
    \bool_set_false:N \l__enumext_resume_count_bool
    \__enumext_if_is_int:nTF {#3}
      {
        \int_set:Nn #2 {#3}
      }
      {
        \regex_if_match:nVT { \c{Alph} | \c{alph} } #1
          { \int_set:Nn #2 { \int_from_alph:n {#3} } }
        \regex_if_match:nVT { \c{Roman} | \c{roman} } #1
          { \int_set:Nn #2  { \int_from_roman:n {#3} } }
      }
  }
\cs_generate_variant:Nn \__enumext_start_from:NNn { ccn, cce }
```

(*End of definition for* __enumext_start_from:NNn.)

__enumext_widest_from:nNNn
__enumext_widest_from:nccn

The function __enumext_widest_from:nNNn used by the widest key takes four arguments:

#1 : The counter associated with the environment level
#2 : \l__enumext_label_X_tl
#3 : \l__enumext_labelwidth_X_dim
#4 : ⟨*integer or string*⟩

The arguments '#2' and '#3' are the values set by label and labelwidth keys, '#4' can be an ⟨*integer*⟩ or ⟨*string*⟩ of the form \Alph, \alph, \Roman or \roman. The value of '#4' is set temporarily for the identified counter in this point (level), then the value is expanded into a *"box"* and the *"width"* of the *"box"* is returned.

```
\cs_new_protected:Nn \__enumext_widest_from:nNNn
  {
    \__enumext_if_is_int:nTF {#4}
      {
        \setcounter{enumX #1} {#4}
      }
      {
        \regex_if_match:nVT { \c{Alph} | \c{alph} } #2
          { \setcounter{enumX #1} { \int_from_alph:n {#4} } }
        \regex_if_match:nVT { \c{Roman} | \c{roman} } #2
          { \setcounter{enumX #1} { \int_from_roman:n {#4} } }
      }
    \__enumext_label_width_by_box:cv
      { l__enumext_labelwidth_ #1 _dim } { l__enumext_label_ #1 _tl }
  }
\cs_generate_variant:Nn \__enumext_widest_from:nNNn { nccn }
```

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(*End of definition for* `\__enumext_widest_from:nNNn`.)

start
start*
widest

Now define and set `start*`, `start` and `widest` keys for `enumext`, `enumext*`, `keyans` and `keyans*` environments.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        start* .code:n =
          {
            \__enumext_start_from:ccn
              { l__enumext_label_ #2 _tl }
              { l__enumext_start_ #2 _int } {##1}
          },
        start* .value_required:n = true,
        start  .code:n =
          {
            \__enumext_start_from:cce
              { l__enumext_label_ #2 _tl }
              { l__enumext_start_ #2 _int } { \int_eval:n {##1} }
          },
        start  .initial:n = 1,
        start  .value_required:n = true,
        widest .code:n =
          {
            \__enumext_widest_from:nccn {#2}
              { l__enumext_label_ #2 _tl }
              { l__enumext_labelwidth_ #2 _dim } {##1}
          },
        widest .value_required:n = true,
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* `start`, `start*`, *and* `widest`.)

13.16 Setting keys for penalties

beginpenalty
midpenalty
endpenalty

The three parameters `\@beginparpenalty`, `\@itempenalty` and `\@endparpenalty` work together to ensure that list environments look good, avoiding unsightly page breaks that can break the flow of the `list`, so it's a good idea to have some ⟨*keys*⟩ to access these.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        beginpenalty .int_set:c = { l__enumext_beginparpenalty_ #2 _int },
        beginpenalty .initial:n = -51,
        beginpenalty .value_required:n = true,
        midpenalty   .int_set:c = { l__enumext_itempenalty_ #2 _int },
        midpenalty   .initial:n = -51,
        midpenalty   .value_required:n = true,
        endpenalty   .int_set:c = { l__enumext_endparpenalty_ #2 _int },
        endpenalty   .initial:n = -51,
        endpenalty   .value_required:n = true,
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* `beginpenalty`, `midpenalty`, *and* `endpenalty`.)

13.17 Setting keys for vertical spaces

topsep
partopsep
parsep
itemsep
noitemsep
nosep

Define and set `topsep`, `partopsep`, `parsep`, `itemsep`, `noitemsep` and `nosep` keys for `enumext`, `enumext*`, `keyans` and `keyans*` environments.

```
\cs_set_protected:Nn \__enumext_tmp:nnnnnn
  {
    \keys_define:nn { enumext / #1 }
      {
        topsep    .skip_set:c = { l__enumext_topsep_ #2 _skip },
```

```
      topsep    .initial:n = {#3},
      topsep    .value_required:n = true,
      partopsep .skip_set:c = { l__enumext_partopsep_ #2 _skip },
      partopsep .initial:n = {#4},
      partopsep .value_required:n = true,
      parsep    .skip_set:c = { l__enumext_parsep_ #2 _skip },
      parsep    .initial:n = {#5},
      parsep    .value_required:n = true,
      itemsep   .skip_set:c = { l__enumext_itemsep_ #2 _skip },
      itemsep   .initial:n = {#6},
      itemsep   .value_required:n = true,
      noitemsep .meta:n = { itemsep = 0pt, parsep = 0pt },
      noitemsep .value_forbidden:n = true,
      nosep     .meta:n =
        { itemsep = 0pt, parsep = 0pt, topsep = 0pt, partopsep = 0pt },
      nosep     .value_forbidden:n = true,
    }
}
```

Now the values are set based on the standard `article` class in `10pt`.

```
\__enumext_tmp:nnnnnn { level-1 } { i } { 8.0pt plus 2.0pt minus 4.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt } { 4.0pt plus 2.0pt minus 1.0pt }
  { 4.0pt plus 2.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { level-2 } { ii } { 4.0pt plus 2.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt } { 2.0pt plus 1.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { level-3 } { iii } { 2.0pt plus 1.0pt minus 1.0pt }
  { 1.0pt minus 1.0pt }{ 0pt }{ 2.0pt plus 1.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { level-4 } { iv } { 2.0pt plus 1.0pt minus 1.0pt }
  { 1.0pt minus 1.0pt }{ 0pt }{ 2.0pt plus 1.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { keyans  } { v }{ 4.0pt plus 2.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt }{ 2.0pt plus 1.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { enumext* } { vii } { 8.0pt plus 2.0pt minus 4.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt } { 4.0pt plus 2.0pt minus 1.0pt }
  { 4.0pt plus 2.0pt minus 1.0pt }
\__enumext_tmp:nnnnnn { keyans* } { viii } { 4.0pt plus 2.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt } { 2.0pt plus 1.0pt minus 1.0pt }
  { 2.0pt plus 1.0pt minus 1.0pt }
```

(*End of definition for* `topsep` *and others.*)

13.18 Setting `base-fix` key

When nesting starting right after `\item` (without material between them) there is a problem with the alignment of the *baseline* between the two environments. One way to get around this problem is to start the paragraph with `\mode_leave_vertical:`, apply a negative `\vspace` and set the keys `topsep`, `above` and `above*` equal to `0pt` for the *"first level"* of the nested `enumext` environment.

`base-fix` Defines the key `base-fix` only for the *"first level"* of `enumext` environment.

```
\keys_define:nn { enumext / level-1 }
  {
    base-fix .bool_set:N = \l__enumext_base_line_fix_bool,
    base-fix .initial:n = false,
    base-fix .value_forbidden:n = true,
  }
```

(*End of definition for* `base-fix`.)

`\__enumext_nested_base_line_fix:` The function `\__enumext_nested_base_line_fix:` passed to the `\__enumext_parse_keys:n` function in the definition of the `enumext` environment (§13.43) will be responsible for applying the *baseline correction* and adjusting the ⟨*keys*⟩ for the `enumext` environment and the `\printkeyans` with *starred argument* '`*`' (§13.51).

First, the function code is implemented from the user side of the `base-fix` key, that is, only the user knows when it is necessary to apply it within the document in which case the variable `\l__enumext_print_keyans_star_bool` set by the `\printkeyans` command is false and the variable `\l__enumext_base_line_fix_bool` is true.

The negative *"vertical space"* is a line of text plus the value of `parsep` of the `enumext*` environment, since this is the gap that TEX leaves between the label of the `\item` and the first line of the nested list. With `columns`

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greater than one this gap does not include the parsep, so only the line of text is removed. The value of \parsep is not used, because inside enumext* it is equal to itemsep.

Sets the values of the keys topsep, above and above* for the *"first level"* of enumext environment equal to 0pt and finally sets the variable \l__enumext_base_line_fix_bool to false.

```
\cs_new_protected:Nn \__enumext_nested_base_line_fix:
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_starred_first_bool }
        { \bool_if_p:N \l__enumext_base_line_fix_bool }
        { \bool_not_p:n { \l__enumext_print_keyans_star_bool } }
      }
      {
        \mode_leave_vertical:
        \vspace
          {
            -\dim_eval:n
              {
                \baselineskip
                + \int_compare:nNnTF { \l__enumext_columns_i_int } > { 1 }
                  { 0pt }
                  { \l__enumext_parsep_vii_skip }
              }
          }
        \keys_set:nn { enumext / level-1 }
          {
            topsep = 0pt, above = 0pt, above* = 0pt,
          }
      }
```

When the \printkeyans command is run with the *starred argument* '*' the variable is true (\l__enumext_print_keyans_star_bool), and the negative space is added with \skip_vertical:n, the enumext interface of \vskip, instead of \vspace. After \mode_leave_vertical: TEX is in ⟨*horizontal mode*⟩, where \vspace would only store the skip in a \vadjust to be applied after the current line, whereas \vskip ends the (still empty) paragraph and applies the skip immediately. The skip is followed by \skip_vertical:N \c_zero_skip so that the negative space is not the last item of the vertical list.

```
    \bool_lazy_and:nnT
      { \bool_if_p:N \l__enumext_starred_first_bool }
      { \bool_if_p:N \l__enumext_print_keyans_star_bool }
      {
        \mode_leave_vertical:
        \skip_vertical:n { -\baselineskip }
        \skip_vertical:N \c_zero_skip
        \keys_set:nn { enumext / level-1 }
          {
            topsep = 0pt, above = 0pt, above* = 0pt,
          }
      }
    \bool_set_false:N \l__enumext_base_line_fix_bool
  }
```

(*End of definition for* __enumext_nested_base_line_fix:.)

13.19 Setting keys for horizontal spaces

itemindent
rightmargin
listparindent
list-offset
list-indent

Define and set itemindent, rightmargin, listparindent, list-offset and list-indent keys for enumext, enumext*, keyans and keyans* environments.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        itemindent    .dim_set:c = { l__enumext_fake_item_indent_ #2 _dim },
        itemindent    .value_required:n = true,
        rightmargin   .dim_set:c = { l__enumext_rightmargin_ #2 _dim },
        rightmargin   .value_required:n = true,
        listparindent .dim_set:c = { l__enumext_listparindent_ #2 _dim },
        listparindent .value_required:n = true,
        list-offset   .dim_set:c = { l__enumext_listoffset_ #2 _dim },
        list-offset   .value_required:n = true,
```

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```
        list-indent   .code:n =
          {
            \bool_set_true:c { l__enumext_leftmargin_tmp_ #2 _bool }
            \dim_set:cn { l__enumext_leftmargin_tmp_ #2 _dim } {##1}
          },
        list-indent   .value_required:n = true,
      }
  }
\clist_map_inline:nn
  {
    {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv}, {keyans}{v}
  }
  { \__enumext_tmp:nn #1 }
```

For `enumext*` and `keyans*` environments the situation is a bit different, the `list-indent` key behaves like the `list-offset` key.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        itemindent    .dim_set:c = { l__enumext_fake_item_indent_ #2 _dim },
        itemindent    .value_required:n = true,
        rightmargin   .dim_set:c = { l__enumext_rightmargin_ #2 _dim },
        rightmargin   .value_required:n = true,
        listparindent .dim_set:c = { l__enumext_listparindent_ #2 _dim },
        listparindent .value_required:n = true,
        list-offset   .dim_set:c = { l__enumext_listoffset_ #2 _dim },
        list-offset   .value_required:n = true,
        list-indent   .meta:n = { list-offset = ##1 },
        list-indent   .value_required:n = true,
      }
  }
\clist_map_inline:nn
  {
    {enumext*}{vii}, {keyans*}{viii}
  }
  { \__enumext_tmp:nn #1 }
```

(*End of definition for* `itemindent` *and others.*)

13.19.1 Functions for setting the fake `itemindent`

`\__enumext_fake_item_indent:`
`\__enumext_keyans_fake_item_indent:`
`\__enumext_fake_item_indent_vii:`
`\__enumext_fake_item_indent_viii:`

The `itemindent` key does not set the value of `\itemindent`, it only sets the value of the *horizontal space* applied using `\skip_horizontal:N`. This value is stored in the variable and only applied when it is greater than `0pt`. Here it is necessary to place `\mode_leave_vertical:` and the plain TEX macro `\ignorespaces` to avoid unwanted extra space when using the `itemindent` key.

```
\cs_set_protected:Nn \__enumext_fake_item_indent:
  {
    \dim_compare:nNnT
      { \dim_use:c { l__enumext_fake_item_indent_ \__enumext_level: _dim } }
      >
      { \c_zero_dim }
      {
        \tl_set:ce { l__enumext_fake_item_indent_ \__enumext_level: _tl }
          {
            \exp_not:N \mode_leave_vertical:
            \exp_not:n { \skip_horizontal:n }
              { \dim_use:c { l__enumext_fake_item_indent_ \__enumext_level: _dim } }
            \exp_not:N \ignorespaces
          }
      }
  }
\cs_set_protected:Nn \__enumext_keyans_fake_item_indent:
  {
    \dim_compare:nNnT
      { \l__enumext_fake_item_indent_v_dim } > { \c_zero_dim }
      {
        \tl_set:Ne \l__enumext_fake_item_indent_v_tl
          {
```

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```
            \exp_not:N \mode_leave_vertical:
            \exp_not:N \skip_horizontal:N \l__enumext_fake_item_indent_v_dim
            \exp_not:N \ignorespaces
          }
      }
  }
\cs_set_protected:Nn \__enumext_fake_item_indent_vii:
  {
    \dim_compare:nNnT
      { \l__enumext_fake_item_indent_vii_dim } > { \c_zero_dim }
      {
        \tl_set:Ne \l__enumext_fake_item_indent_vii_tl
          {
            \exp_not:N \skip_horizontal:N \l__enumext_fake_item_indent_vii_dim
            \exp_not:N \ignorespaces
          }
      }
  }
\cs_set_protected:Nn \__enumext_fake_item_indent_viii:
  {
    \dim_compare:nNnT
      { \l__enumext_fake_item_indent_viii_dim } > { \c_zero_dim }
      {
        \tl_set:Ne \l__enumext_fake_item_indent_viii_tl
          {
            \exp_not:N \skip_horizontal:N \l__enumext_fake_item_indent_viii_dim
            \exp_not:N \ignorespaces
          }
      }
  }
```

(*End of definition for* `\__enumext_fake_item_indent:` *and others.*)

13.20 Setting `show-length` key

show-length

Define and set `show-length` key for `enumext`, `enumext*`, `keyans` and `keyans*` environments. The function sets the boolean variable `\l__enumext_show_length_X_bool` used in the definition of all environments to `true` and calls the function `\__enumext_show_length:nnn` which prints all the values of the *"vertical"* and *"horizontal"* parameters calculated and used.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        show-length .bool_set:c = { l__enumext_show_length_ #2 _bool },
        show-length .initial:n = false,
        show-length .value_required:n = true,
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* `show-length`.)

13.21 Setting `item-break` key

item-break

Define and set `item-break` key for `enumext*` and `keyans*` environments. The key sets the boolean variable `\l__enumext_item_break_X_bool`, which is `false` by default, and is used when each `\item` starts (§13.48).

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        item-break .bool_set:c = { l__enumext_item_break_ #2 _bool },
        item-break .initial:n = false,
        item-break .value_required:n = true,
      }
  }
\clist_map_inline:nn { {enumext*}{vii}, {keyans*}{viii} } { \__enumext_tmp:nn #1 }
```

(*End of definition for* `item-break`.)

13.22 Setting before, after and first keys

before
before*
after
first

Define and set before, before*, after and first keys for enumext, enumext*, keyans and keyans* environments.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        before  .tl_set:c = { l__enumext_before_no_starred_key_ #2 _tl },
        before  .value_required:n = true,
        before* .tl_set:c = { l__enumext_before_starred_key_ #2 _tl },
        before* .value_required:n = true,
        after   .tl_set:c = { l__enumext_after_stop_list_ #2 _tl },
        after   .value_required:n = true,
        first   .tl_set:c = { l__enumext_after_list_args_ #2 _tl },
        first   .value_required:n = true,
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* before *and others.*)

13.22.1 Functions for before, after and first keys in enumext

__enumext_before_args_exec:
__enumext_before_keys_exec:
__enumext_after_stop_list:
__enumext_after_args_exec:

The function __enumext_before_args_exec: executes the {⟨*code*⟩} set by the before* key *"before"* the enumext environment is started. The {⟨*code*⟩} is executed *"without"* knowing any definition of the {⟨*arg two*⟩} of the list: {⟨*code*⟩}\list{⟨*arg one*⟩}{⟨*arg two*⟩}.

```
\cs_new_protected:Nn \__enumext_before_args_exec:
  {
    \tl_use:c { l__enumext_before_starred_key_ \__enumext_level: _tl }
  }
```

The function __enumext_before_keys_exec: executes the {⟨*code*⟩} set by the before key *"before"* the enumext environment is started in *second argument* of the list. The {⟨*code*⟩} is executed *"knowing"* all the definitions and values provided by the ⟨*keys*⟩: \list{⟨*arg one*⟩}{⟨*arg two*⟩{⟨*code*⟩}}

```
\cs_new_protected:Nn \__enumext_before_keys_exec:
  {
    \tl_use:c { l__enumext_before_no_starred_key_ \__enumext_level: _tl }
  }
```

The function __enumext_after_stop_list: executes the {⟨*code*⟩} set by the after key *"after"* the enumext environment has finished: \endlist{⟨*code*⟩}.

```
\cs_new_protected:Nn \__enumext_after_stop_list:
  {
    \tl_use:c { l__enumext_after_stop_list_ \__enumext_level: _tl }
  }
```

The function __enumext_after_args_exec: executes the {⟨*code*⟩} set by the first key after the end of the second argument of the list defining the enumext environment, just before the first occurrence of \item: \list{⟨*arg one*⟩}{⟨*arg two*⟩}{⟨*code*⟩}\item.

```
\cs_new_protected:Nn \__enumext_after_args_exec:
  {
    \tl_use:c { l__enumext_after_list_args_ \__enumext_level: _tl }
  }
```

(*End of definition for* __enumext_before_args_exec: *and others.*)

13.22.2 Functions for before, after and first keys in keyans

__enumext_before_args_exec_v:
__enumext_before_keys_exec_v:
__enumext_after_stop_list_v:
__enumext_after_args_exec_v:

Same implementation as the one used in the enumext environment.

```
\cs_new_protected:Nn \__enumext_before_args_exec_v:
  {
    \tl_use:N \l__enumext_before_starred_key_v_tl
  }
\cs_new_protected:Nn \__enumext_before_keys_exec_v:
  {
    \tl_use:N \l__enumext_before_no_starred_key_v_tl
  }
\cs_new_protected:Nn \__enumext_after_stop_list_v:
```

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```
  {
    \tl_use:N \l__enumext_after_stop_list_v_tl
  }
\cs_new_protected:Nn \__enumext_after_args_exec_v:
  {
    \tl_use:N \l__enumext_after_list_args_v_tl
  }
```

(*End of definition for* `\__enumext_before_args_exec_v:` *and others.*)

13.22.3 Functions for `before`, `after` and `first` keys in `enumext*` and `keyans*`

`\__enumext_before_args_exec_vii:`
`\__enumext_before_args_exec_viii:`
`\__enumext_before_keys_exec_vii:`
`\__enumext_before_keys_exec_viii:`
`\__enumext_after_stop_list_vii:`
`\__enumext_after_stop_list_viii:`

Same implementation as the one used in the `enumext` environment, except that the functions `\__enumext_after_args_exec_vii:` and `\__enumext_after_args_exec_viii:` do not exist. Instead, the {⟨*code*⟩} set by the `first` key is used directly by `\__enumext_start_item_vii:w` and `\__enumext_start_item_viii:w` inside the `minipage` of each `\item`.

```
\cs_new_protected:Nn \__enumext_before_args_exec_vii:
  {
    \tl_use:N \l__enumext_before_starred_key_vii_tl
  }
\cs_new_protected:Nn \__enumext_before_args_exec_viii:
  {
    \tl_use:N \l__enumext_before_starred_key_viii_tl
  }
\cs_new_protected:Nn \__enumext_before_keys_exec_vii:
  {
    \tl_use:N \l__enumext_before_no_starred_key_vii_tl
  }
\cs_new_protected:Nn \__enumext_before_keys_exec_viii:
  {
    \tl_use:N \l__enumext_before_no_starred_key_viii_tl
  }
\cs_new_protected:Nn \__enumext_after_stop_list_vii:
  {
    \tl_use:N \l__enumext_after_stop_list_vii_tl
  }
\cs_new_protected:Nn \__enumext_after_stop_list_viii:
  {
    \tl_use:N \l__enumext_after_stop_list_viii_tl
  }
```

(*End of definition for* `\__enumext_before_args_exec_vii:` *and others.*)

13.23 Setting keys for `multicols` and `minipage`

`mini-env`
`mini-sep`
`columns-sep`
`columns`
`mini-right`
`mini-right*`

The default value of the `columns-sep` key is zero; when the value is zero it is calculated in the internal definition of the environments from the dimension variable `\l__enumext_columns_sep_X_dim`. Define and set `mini-env`, `mini-sep`, `columns-sep` and `columns` keys for `enumext`, `enumext*`, `keyans` and `keyans*` environments.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        mini-env    .dim_set:c = { l__enumext_minipage_right_ #2 _dim },
        mini-env    .value_required:n = true,
        mini-sep    .dim_set:c = { l__enumext_minipage_hsep_ #2 _dim },
        mini-sep    .initial:n = 0.3333em,
        mini-sep    .value_required:n = true,
        columns-sep .dim_set:c = { l__enumext_columns_sep_ #2 _dim },
        columns-sep .value_required:n = true,
        columns     .int_set:c = { l__enumext_columns_ #2 _int },
        columns     .initial:n = 1,
        columns     .value_required:n = true,
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

For `enumext*` and `keyans*` environments the situation is a bit different, the command `\miniright` is not available, so the keys `mini-right` and `mini-right*` are added to implement support for `minipage` environment.

```
\cs_set_protected:Nn \__enumext_tmp:nn
```

```
  {
    \keys_define:nn { enumext / #1 }
      {
        mini-right  .tl_gset:c = { g__enumext_miniright_code_ #2 _tl },
        mini-right  .value_required:n = true,
        mini-right* .code:n =
          {
            \bool_gset_true:c { g__enumext_minipage_center_ #2 _bool }
            \keys_set:nn { enumext / #1 } { mini-right = {##1} }
          },
        mini-right* .value_required:n = true,
      }
  }
\clist_map_inline:nn { {enumext*}{vii}, {keyans*}{viii} } { \__enumext_tmp:nn #1 }
```

(*End of definition for* `mini-env` *and others.*)

13.24 Adjustment of vertical spaces for `multicols`

When nesting a *"list environment"* inside the `multicols` environment, the values of the *"vertical spaces"* are lost, basically the `multicols` environment takes control over them. Graphically, this can be seen in figure 7.



Figure 7: Representation of the vertical space in `multicols` for a nested level.

To keep the desired spaces *above* and *below* in the *"list environment"* (`\topsep + [\partopsep]`) it is necessary to *"adjust"* the spaces added by the `multicols` environment. The most appropriate option in this case is to use a *"context sensitive"* vertical space with `\addvspace`.

It should be made clear that the implementation here is a *"bit questionable"*. At first glance doing `\multicolsep=\topsep` seemed right, but the results were not always as expected. An almost *imperceptible* detail is that in some cases the `\itemsep` values are *"stretched"*, possibly due to the use of `\raggedcolumns` and this affects the lower space when closing the environment, which is *"smaller"* than expected. My attempts to find the correct values using `\showoutput` and `\showboxdepth` absolutely failed.

13.24.1 Adjustment of vertical spaces for `multicols` in `enumext`

`\__enumext_multi_set_vskip:`

The function `\__enumext_multi_set_vskip:` will take care of determining the *"adjusted spaces"* applied *"above"* and *"below"* the `multicols` environment in `enumext`.

The default values are set taking into account that TEX is in ⟨*horizontal mode*⟩, then the settings for the ⟨*vertical mode*⟩, in which `\partopsep` comes into play, are made.

Set `\l__enumext_multicols_above_X_skip` and `\l__enumext_multicols_below_X_skip` equal to the value of `\topsep` in the *current level*.

```
\cs_new_protected:Nn \__enumext_multi_set_vskip:
  {
    \skip_set:cn { l__enumext_multicols_above_ \__enumext_level: _skip }
      {
        \skip_use:c { l__enumext_topsep_ \__enumext_level: _skip }
      }
    \skip_set:cn { l__enumext_multicols_below_ \__enumext_level: _skip }
      {
        \skip_use:c { l__enumext_topsep_ \__enumext_level: _skip }
      }
    \__enumext_add_pre_parsep:
  }
```

(*End of definition for* `\__enumext_multi_set_vskip:`.)

`\__enumext_add_pre_parsep:`

Since `\parsep` in the previous level affects the *vertical spaces*, the function `\__enumext_add_pre_parsep:` detects its value and *"adjusts"* `\l__enumext_multicols_above_X_skip`.

```
\cs_new_protected:Nn \__enumext_add_pre_parsep:
  {
    \int_case:nn { \l__enumext_level_int }
      {
        { 2 }
```

```
      {
        \skip_if_eq:nnF { \l__enumext_parsep_i_skip } { \c_zero_skip }
          {
            \skip_add:Nn \l__enumext_multicols_above_ii_skip
              {
                \l__enumext_parsep_i_skip
              }
          }
      }
    { 3 }
      {
        \skip_if_eq:nnF { \l__enumext_parsep_ii_skip } { \c_zero_skip }
          {
            \skip_add:Nn \l__enumext_multicols_above_iii_skip
              {
                \l__enumext_parsep_ii_skip
              }
          }
      }
    { 4 }
      {
        \skip_if_eq:nnF { \l__enumext_parsep_iii_skip } { \c_zero_skip }
          {
            \skip_add:Nn \l__enumext_multicols_above_iv_skip
              {
                \l__enumext_parsep_iii_skip
              }
          }
      }
  }
```

(*End of definition for* `\__enumext_add_pre_parsep:`.)

`\__enumext_multi_addvspace:`

The function `\__enumext_multi_addvspace:` will apply the spaces set using `\addvspace` *"above"* the `multicols` environment in `enumext`, taking into account whether TEX is in ⟨*horizontal mode*⟩ or ⟨*vertical mode*⟩.

```
\cs_new_protected:Nn \__enumext_multi_addvspace:
  {
    \__enumext_multi_set_vskip:
    \mode_if_vertical:T
      {
        \skip_add:cn { l__enumext_multicols_above_ \__enumext_level: _skip }
          {
            \skip_use:c { l__enumext_partopsep_ \__enumext_level: _skip }
          }
        \skip_add:cn { l__enumext_multicols_below_ \__enumext_level: _skip }
          {
            \skip_use:c { l__enumext_partopsep_ \__enumext_level: _skip }
          }
      }
    \par\nopagebreak
    \addvspace{ \skip_use:c { l__enumext_multicols_above_ \__enumext_level: _skip } }
  }
```

(*End of definition for* `\__enumext_multi_addvspace:`.)

13.24.2 Adjustment of vertical spaces for `multicols` in `keyans`

`\__enumext_keyans_multi_set_vskip:`
`\__enumext_keyans_multi_addvspace:`

The function `\__enumext_keyans_multi_set_vskip:` will take care of determining the *"adjusted spaces"* applied *"above"* and *"below"* the `multicols` environment in `keyans`. The implementation of this function is the same as the one used in `enumext`, including the value of `\parsep` of the previous level, which is added to the space *"above"*.

```
\cs_new_protected:Nn \__enumext_keyans_multi_set_vskip:
  {
    \skip_set:Nn \l__enumext_multicols_above_v_skip
      {
        \l__enumext_topsep_v_skip
      }
    \skip_set:Nn \l__enumext_multicols_below_v_skip
```

```
      {
        \l__enumext_topsep_v_skip
      }
    \skip_if_eq:nnF { \l__enumext_parsep_i_skip } { \c_zero_skip }
      {
        \skip_add:Nn \l__enumext_multicols_above_v_skip { \l__enumext_parsep_i_skip }
      }
  }
\cs_new_protected:Nn \__enumext_keyans_multi_addvspace:
  {
    \__enumext_keyans_multi_set_vskip:
    \mode_if_vertical:T
      {
        \skip_add:Nn \l__enumext_multicols_above_v_skip
          {
            \skip_use:N \l__enumext_partopsep_v_skip
          }
        \skip_add:Nn \l__enumext_multicols_below_v_skip
          {
            \skip_use:N \l__enumext_partopsep_v_skip
          }
      }
    \par\nopagebreak
    \addvspace{ \l__enumext_multicols_above_v_skip }
  }
```

(*End of definition for* `\__enumext_keyans_multi_set_vskip:` *and* `\__enumext_keyans_multi_addvspace:`.)

13.25 Adjustment of vertical spaces for `minipage`

When nesting a *"list environment"* within the `minipage` environment, the values of the *"vertical spaces"* are lost. Graphically it can be seen like in the figure 8.



Figure 8: Representation of the `minipage` spacing adjustment for a nested level.

To keep the *"left"* and *"right"* environments *"aligned on top"*, preserving the `\baselineskip` and keeping the desired *"spaces"* (`\topsep + [\partopsep]`) it is necessary to *"adjust"* the *"vertical spaces"* for `minipage` environments.

Here there are several complications that must be circumvented: the `minipage` environment eliminates the "top" spaces, the `multicols` environment can be nested in the `minipage` environment, the "top" and "bottom" spaces are affected when `topsep=0pt` and to this is added the `\partopsep` parameter that comes into action according to whether TEX is in ⟨*horizontal mode*⟩ or ⟨*vertical mode*⟩. Depending on these cases, the spaces are computed and added with `\addvspace` to obtain the *"desired vertical spacing"*.

The "top" and "bottom" spaces cannot be read directly from the *glue* produced by the `minipage` environment, and when `multicols` is nested the depth of its last line is lost when it ends. For this reason the spaces on the *"left side"* are not obtained from fixed fractions of `\strutbox`: the space *"above"* is computed from `\prevdepth` and the current `\baselineskip`, which is the same *glue* that TEX inserts between two lines, and the space *"below"* is stored together with the depth of the last line when the environment on the *"left side"* ends, to be applied once the environment on the *"right side"* is closed. In this way the spaces follow the size of the font used in the document.

13.25.1 Definition of variables

`\l__enumext_minipage_right_skip`
`\l__enumext_mini_prev_dim`
`\l__enumext_mini_gap_dim`
`\l__enumext_mini_last_box`
`\g__enumext_mini_dp_dim`
`\g__enumext_mini_end_skip`
`\g__enumext_mini_end_bool`

Internal variables used by the keys `mini-env` and `mini-sep` (§13.25). The space applied *"above"* the `\__enumext_mini_page` environment on the *"right side"* and *"below"* the `multicols` environment is held by the skip `\l__enumext_minipage_right_skip`. The variables `\l__enumext_mini_prev_dim`, `\l__enumext_mini_gap_dim` and `\l__enumext_mini_last_box` are used to compute the space *"above"* and to recover the last box of the `multicols` environment. The variables `\g__enumext_mini_dp_dim` and `\g__enumext_mini_end_skip` store the depth of the last line and the space *"below"*, and the boolean `\g__enumext_mini_end_bool` indicates that both are pending to be applied.

```
\skip_new:N \l__enumext_minipage_right_skip
\dim_new:N  \l__enumext_mini_prev_dim
\dim_new:N  \l__enumext_mini_gap_dim
\box_new:N  \l__enumext_mini_last_box
\dim_new:N  \g__enumext_mini_dp_dim
```

```
\skip_new:N \g__enumext_mini_end_skip
\bool_new:N \g__enumext_mini_end_bool
```

(*End of definition for* `\l__enumext_minipage_right_skip` *and others.*)

13.25.2 Definition of error messages

wrong-miniright-place
wrong-miniright-use
wrong-miniright-starred
many-miniright-used

Messages used by `\miniright` command.

```
\msg_new:nnnn { enumext } { wrong-miniright-place }
  {
    Wrong~place~for~'\token_to_str:N \miniright'~\msg_line_context:.
  }
  {
    Works~in~'enumext'~and~'keyans'~with~key~'mini-env'.
  }
\msg_new:nnnn { enumext } { wrong-miniright-use }
  {
    Wrong~use~for~'\token_to_str:N \miniright'~\msg_line_context:.
  }
  {
    '\token_to_str:N \miniright'~needs~a~key~'mini-env'.
  }
\msg_new:nnnn { enumext } { wrong-miniright-starred }
  {
    Can't~use~'\token_to_str:N \miniright'~in~starred~environments~
    \msg_line_context:.
  }
  {
    In~'enumext*'~and~'keyans*'~use~the~keys~'mini-right'~or~
    'mini-right*'~instead.
  }
\msg_new:nnnn { enumext } { many-miniright-used }
  {
    Can't~use~'\token_to_str:N \miniright'~more~than~once~
    \msg_line_context:.
  }
  {
    '\token_to_str:N \miniright'~can~be~used~only~once~in~each~
    environment.
  }
```

(*End of definition for* `wrong-miniright-place` *and others.*)

13.25.3 Computation of the vertical spaces for `minipage`

__enumext_mini_baselineskip:

The function `\__enumext_mini_baselineskip:` adds with `\addvspace` the space that TEX would insert between the previous line and a line of text whose height is that of the letter "l", that is, `\baselineskip` minus `\prevdepth` minus that height, never less than `\lineskip`. If there is no previous line (`\prevdepth` is `-1000pt`) the space is zero. The `\nointerlineskip` command is executed before the space is added, to prevent the *glue* of the baseline from being added again between this space and the next box.

```
\cs_new_protected:Nn \__enumext_mini_baselineskip:
  {
    \dim_set:Nn \l__enumext_mini_prev_dim { \prevdepth }
    \nointerlineskip
    \dim_compare:nNnTF { \l__enumext_mini_prev_dim } < { -999pt }
      { \dim_zero:N \l__enumext_mini_gap_dim }
      {
        \dim_set:Nn \l__enumext_mini_gap_dim
          { \baselineskip - \l__enumext_mini_prev_dim - \fontcharht\font`l }
        \dim_compare:nNnT { \l__enumext_mini_gap_dim } < { \lineskip }
          { \dim_set_eq:NN \l__enumext_mini_gap_dim \lineskip }
      }
    \addvspace{ \l__enumext_mini_gap_dim }
  }
```

(*End of definition for* `\__enumext_mini_baselineskip:`.)

__enumext_mini_capture_end:
__enumext_mini_capture_multicols:
__enumext_mini_apply_end:

The function `\__enumext_mini_capture_end:` stores in `\g__enumext_mini_dp_dim` the value of `\prevdepth`, removes the last *glue* (if any) saving its value in `\g__enumext_mini_end_skip` and sets `\g__enumext_mini_end_bool` to `true`. The function `\__enumext_mini_capture_multicols:` does the same after a `multicols` environment, where `\prevdepth` is not reliable: the last box

is recovered with \lastbox, its depth is stored and the box is put back, and the stored space is \l__enumext_minipage_right_skip. The function __enumext_mini_apply_end: is called after closing the environment on the *"right side"*: if there is something stored, it restores \prevdepth and adds the stored space with \addvspace, so that the space *"below"* is measured from the last line of the environment on the *"left side"*.

```
\cs_new_protected:Nn \__enumext_mini_capture_end:
  {
    \dim_gset:Nn \g__enumext_mini_dp_dim { \prevdepth }
    \skip_gzero:N \g__enumext_mini_end_skip
    \int_compare:nNnT { \lastnodetype } = { 11 }
      {
        \skip_gset:Nn \g__enumext_mini_end_skip { \lastskip }
        \unskip
      }
    \bool_gset_true:N \g__enumext_mini_end_bool
  }
\cs_new_protected:Nn \__enumext_mini_capture_multicols:
  {
    \int_compare:nNnTF { \lastnodetype } = { 1 }
      {
        \box_set_to_last:N \l__enumext_mini_last_box
        \dim_gset:Nn \g__enumext_mini_dp_dim { \box_dp:N \l__enumext_mini_last_box }
        \nointerlineskip
        \box_use_drop:N \l__enumext_mini_last_box
      }
      { \dim_gset:Nn \g__enumext_mini_dp_dim { \prevdepth } }
    \skip_gset_eq:NN \g__enumext_mini_end_skip \l__enumext_minipage_right_skip
    \bool_gset_true:N \g__enumext_mini_end_bool
  }
\cs_new_protected:Nn \__enumext_mini_apply_end:
  {
    \bool_if:NT \g__enumext_mini_end_bool
      {
        \par
        \dim_compare:nNnF { \g__enumext_mini_dp_dim } < { -999pt }
          { \dim_set_eq:NN \prevdepth \g__enumext_mini_dp_dim }
        \addpenalty { \@endparpenalty }
        \addvspace { \g__enumext_mini_end_skip }
        \bool_gset_false:N \g__enumext_mini_end_bool
      }
  }
```

(*End of definition for* __enumext_mini_capture_end:, __enumext_mini_capture_multicols:, *and* __enumext_mini_apply_end:.)

13.25.4 Adjustment of vertical spaces for minipage in enumext

__enumext_minipage_set_skip:
__enumext_minipage_add_space:

In the enumext environment, the function __enumext_minipage_set_skip: will take care of determining the value of \l__enumext_minipage_right_skip, the space applied *"above"* the __enumext_mini_page environment on the *"right side"* and *"below"* the multicols environment.

First it sets the value of \l__enumext_minipage_right_skip equal to \topsep, then checks if TEX is in ⟨*vertical mode*⟩ and, if so, adds \partopsep.

```
\cs_new_protected:Nn \__enumext_minipage_set_skip:
  {
    \skip_set:Nn \l__enumext_minipage_right_skip
      {
        \skip_use:c { l__enumext_topsep_ \__enumext_level: _skip }
      }
    \mode_if_vertical:T
      {
        \skip_add:Nn \l__enumext_minipage_right_skip
          {
            \skip_use:c { l__enumext_partopsep_ \__enumext_level: _skip }
          }
      }
```

Sets the value of the variable \l__enumext_multicols_above_X_skip equal to the value of the variable \l__enumext_minipage_right_skip.

```
    \skip_set_eq:cN
      { l__enumext_multicols_above_ \__enumext_level: _skip }
      \l__enumext_minipage_right_skip
```

If the environment multicols is active, it sets \topskip=0pt and then makes \multicolsep have the same value as \l__enumext_multicols_above_X_skip.

```
    \int_compare:nNnT
      { \int_use:c { l__enumext_columns_ \__enumext_level: _int } } > { 1 }
      {
        \skip_zero:N \topskip
        \skip_set_eq:Nc \multicolsep
          { l__enumext_multicols_above_ \__enumext_level: _skip }
      }
  }
```

The function __enumext_minipage_add_space: will apply the spaces on the *"left side"* using \addvspace *"above"* the __enumext_mini_page environment, taking into account whether TEX is in ⟨*horizontal mode*⟩ or ⟨*vertical mode*⟩. First the last ⟨*skip*⟩ or ⟨*kern*⟩ is removed; in ⟨*vertical mode*⟩ only \nopagebreak is added, while in ⟨*horizontal mode*⟩ the paragraph is ended and \partopsep is set to zero, since this parameter comes into play according to the mode and this affects the *vertical spacing*. The space is then added with the function __enumext_mini_baselineskip:.

```
\cs_new_protected:Nn \__enumext_minipage_add_space:
  {
    \__enumext_minipage_set_skip:
    \__enumext_unskip_unkern:
    \mode_if_vertical:TF
      {
        \nopagebreak
      }
      {
        \par\nopagebreak
        \skip_zero:c { l__enumext_partopsep_ \__enumext_level: _skip }
      }
    \__enumext_mini_baselineskip:
  }
```

(*End of definition for* __enumext_minipage_set_skip: *and* __enumext_minipage_add_space:.)

13.25.5 Adjustment of vertical spaces for minipage in keyans

__enumext_keyans_minipage_set_skip:
__enumext_keyans_minipage_add_space:

The function __enumext_keyans_minipage_set_skip: will take care of determining the value of \l__enumext_minipage_right_skip in keyans. The implementation of this function is the same as the one used in enumext.

```
\cs_new_protected:Nn \__enumext_keyans_minipage_set_skip:
  {
    \skip_zero:N \l__enumext_minipage_right_skip
    \skip_set:Nn \l__enumext_minipage_right_skip
      {
        \l__enumext_topsep_v_skip
      }
    \mode_if_vertical:T
      {
        \skip_add:Nn \l__enumext_minipage_right_skip
          {
            \l__enumext_partopsep_v_skip
          }
      }
    \skip_set_eq:NN \l__enumext_multicols_above_v_skip \l__enumext_minipage_right_skip
    \int_compare:nNnT { \l__enumext_columns_v_int } > { 1 }
      {
        \skip_zero:N \topskip
        \skip_set_eq:NN \multicolsep \l__enumext_minipage_right_skip
      }
  }
\cs_new_protected:Nn \__enumext_keyans_minipage_add_space:
  {
    \__enumext_keyans_minipage_set_skip:
    \__enumext_unskip_unkern:
    \mode_if_vertical:TF
      {
        \nopagebreak
      }
      {
        \par\nopagebreak
```

```
      \skip_zero:N \l__enumext_partopsep_v_skip
    }
  \__enumext_mini_baselineskip:
}
```

(*End of definition for* `\__enumext_keyans_minipage_set_skip:` *and* `\__enumext_keyans_minipage_add_space:`.)

13.25.6 Adjustment of vertical spaces for `minipage` in `enumext*` and `keyans*`

`\__enumext_mini_set_vskip_vii:`
`\__enumext_mini_set_vskip_viii:`

The functions `\__enumext_mini_set_vskip_vii:` and `\__enumext_mini_set_vskip_viii:` will take care of determining the space applied *"above"* the `\__enumext_mini_page` environment on the *"right side"* in `enumext*` and `keyans*`. It is stored in `\g__enumext_minipage_right_skip` and has the same value as the `\topsep` of the environment, which is the space that the list adds above the environment on the *"left side"*.

```
\cs_new_protected:Nn \__enumext_mini_set_vskip_vii:
  {
    \skip_gset:Nn \g__enumext_minipage_right_skip { \l__enumext_topsep_vii_skip }
  }
\cs_new_protected:Nn \__enumext_mini_set_vskip_viii:
  {
    \skip_gset:Nn \g__enumext_minipage_right_skip { \l__enumext_topsep_viii_skip }
  }
```

(*End of definition for* `\__enumext_mini_set_vskip_vii:` *and* `\__enumext_mini_set_vskip_viii:`.)

`\__enumext_mini_addvspace_vii:`
`\__enumext_mini_addvspace_viii:`

The functions `\__enumext_mini_addvspace_vii:` and `\__enumext_mini_addvspace_viii:` will apply the vertical space *"only above"* the `\__enumext_mini_page` environment on the *left side* when the `mini-right` key is active in the `enumext*` and `keyans*` environments, using the function `\__enumext_mini_baselineskip:`.

Here it does NOT take into account whether TEX is in ⟨*horizontal mode*⟩ or ⟨*vertical mode*⟩, since `\partopsep` is equal to `0pt` in both environments.

```
\cs_new_protected:Nn \__enumext_mini_addvspace_vii:
  {
    \__enumext_mini_set_vskip_vii:
    \par\nopagebreak
    \__enumext_mini_baselineskip:
  }
\cs_new_protected:Nn \__enumext_mini_addvspace_viii:
  {
    \__enumext_mini_set_vskip_viii:
    \par\nopagebreak
    \__enumext_mini_baselineskip:
  }
```

(*End of definition for* `\__enumext_mini_addvspace_vii:` *and* `\__enumext_mini_addvspace_viii:`.)

13.25.7 The command `\miniright`

The command `\miniright` will close the `\__enumext_mini_page` environment on the *"left side"*, open the `\__enumext_mini_page` environment on the *"right side"* adding the *adjusted vertical space*. By default `\centering` is added when starting the *"right side"* environment. The *starred argument* '`*`' inhibits the use of `\centering` command i.e. the usual LATEX justification is maintained in the `\__enumext_mini_page` on the *"right side"*.

`\miniright`

The command accepts a *starred argument* '`*`' in '`#1`'. First, some checks prevent the command from being executed outside the `enumext` environment or somewhere inappropriate. Only the first error found is reported and the command does nothing else. Then the internal functions are called to execute it in the `enumext` and `keyans` environments.

```
\NewDocumentCommand \miniright { s }
  {
    % outside
    \bool_lazy_or:nnTF
      { \int_compare_p:nNn { \l__enumext_keyans_pic_level_int } = { 1 } }
      {
        \bool_lazy_and_p:nn
          { \int_compare_p:nNn { \l__enumext_level_int } = { 0 } }
          { \int_compare_p:nNn { \l__enumext_level_h_int } = { 0 } }
      }
      {
        \msg_error:nn { enumext } { wrong-miniright-place }
```

```
      }
      {
        % starred env
        \bool_lazy_and:nnTF
          { \bool_if_p:N \g__enumext_starred_bool }
          { \bool_not_p:n { \l__enumext_standard_bool } }
          {
            \msg_error:nn { enumext } { wrong-miniright-starred }
          }
          {
            % exec
            \int_compare:nNnTF { \l__enumext_keyans_level_int } = { 1 }
              {
                \__enumext_keyans_mini_right_cmd:n {#1}
              }
              { \__enumext_mini_right_cmd:n {#1} }
          }
      }
  }
```

(*End of definition for* `\miniright`. *This function is documented on page 13.*)

`\__enumext_mini_right_cmd:n`

The function `\__enumext_mini_right_cmd:n` takes as argument the *starred* '`*`' of the `\miniright` command in the `enumext` environment. It checks if the `mini-env` key is active via the variable `\l__enumext_minipage_right_X_dim`; if so, it closes the `multicols` environment with the `\__enumext_mini_page` environment on the *"left side"*, then opens the `\__enumext_mini_page` environment on the *"right side"*, applies the adjusted *"vertical space"* above it, followed by adding the `\centering` command when the *starred argument* '`*`' is not present, and sets `\g__enumext_minipage_stat_int` to zero; otherwise it returns an error. Before closing the environment on the *"left side"* the space *"below"* is stored with `\__enumext_mini_capture_end:` (or with `\__enumext_mini_capture_multicols:` when `multicols` is active), to be applied after the environment on the *"right side"*.

```
\cs_new_protected:Nn \__enumext_mini_right_cmd:n
  {
    \dim_compare:nNnTF
      { \dim_use:c { l__enumext_minipage_right_ \__enumext_level: _dim } }
      > { \c_zero_dim }
      {
        \__enumext_multicols_stop:
        \int_compare:nNnT
          { \int_use:c { l__enumext_columns_ \__enumext_level: _int } } = { 1 }
          {
            \par
            \__enumext_mini_capture_end:
          }
        \end__enumext_mini_page
        \hfill
        \__enumext_mini_page
          { \dim_use:c { l__enumext_minipage_right_ \__enumext_level: _dim } }
          \par\nointerlineskip
          \addvspace { \l__enumext_minipage_right_skip }
          \bool_if:nF {#1}
            {
              \centering
            }
          \int_gzero:N \g__enumext_minipage_stat_int
      }
      { \msg_error:nn { enumext } { wrong-miniright-use } }
    % paranoia
    \RenewDocumentCommand \miniright { s }
      {
        \msg_error:nn { enumext } { many-miniright-used }
      }
  }
```

(*End of definition for* `\__enumext_mini_right_cmd:n`.)

`\__enumext_keyans_mini_right_cmd:n`

The function `\__enumext_keyans_mini_right_cmd:n` takes as argument the *starred* '`*`' of the `\miniright` command in the `keyans` environment. The implementation of this function is the same as that of the `\__enumext_mini_right_cmd:n` function of the `enumext` environment.

```
\cs_new_protected:Nn \__enumext_keyans_mini_right_cmd:n
```

```
{
  \dim_compare:nNnTF { \l__enumext_minipage_right_v_dim } > { \c_zero_dim }
    {
      \__enumext_keyans_multicols_stop:
      \int_compare:nNnT { \l__enumext_columns_v_int } = { 1 }
        {
          \par
          \__enumext_mini_capture_end:
        }
      \end__enumext_mini_page
      \hfill
      \__enumext_mini_page{ \l__enumext_minipage_right_v_dim }
        \par\nointerlineskip
        \addvspace { \l__enumext_minipage_right_skip }
        \bool_if:nF {#1}
          {
            \centering
          }
        \int_gzero:N \g__enumext_minipage_stat_int
    }
    { \msg_error:nn { enumext } { wrong-miniright-use } }
  % paranoia
  \RenewDocumentCommand \miniright { s }
    {
      \msg_error:nn { enumext } { many-miniright-used }
    }
}
```

(*End of definition for* `\__enumext_keyans_mini_right_cmd:n`.)

13.26 Setting above and below keys

While having controlled the *vertical spaces* within the enumext and keyans environments when using the columns or mini-env keys, sometimes the *"vertical spaces above"* or *"vertical spaces below"* the environments are not as expected and it is necessary to be able to apply a *"fine correction"* to these. Since these *glitches* cannot be corrected completely, the best option is to provide a couple of ⟨*keys*⟩ dedicated to this purpose, in this case it is best to use \vspace or \vspace* when convenient.

`\l__enumext_vspace_a_star_X_bool`
`\l__enumext_vspace_b_star_X_bool`

The boolean vars `\l__enumext_vspace_a_star_X_bool` and `\l__enumext_vspace_b_star_X_bool` are used by above, above*, below and below* keys.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_vspace_a_star_ #1 _bool }
    \bool_new:c { l__enumext_vspace_b_star_ #1 _bool }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_vspace_a_star_X_bool` *and* `\l__enumext_vspace_b_star_X_bool`.)

above
above*
below
below*

Define above, above*, below and below* keys for enumext and keyans environments.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        above  .skip_set:c = { l__enumext_vspace_above_ #2 _skip },
        above  .value_required:n = true,
        above* .code:n =
          {
            \bool_set_true:c { l__enumext_vspace_a_star_ #2 _bool }
              \keys_set:nn { enumext / #1 } { above = {##1} }
          },
        above* .value_required:n = true,
        below  .skip_set:c = { l__enumext_vspace_below_ #2 _skip },
        below  .value_required:n = true,
        below* .code:n =
          {
            \bool_set_true:c { l__enumext_vspace_b_star_ #2 _bool }
              \keys_set:nn { enumext / #1 } { below = {##1} }
          },
        below* .value_required:n = true,
```

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```
      }
  }
\clist_map_inline:Nn \c__enumext_all_envs_clist { \__enumext_tmp:nn #1 }
```

(*End of definition for* above *and others.*)

13.26.1 Functions for above and below keys in enumext

__enumext_vspace_above: The function __enumext_vspace_above: applies the *vertical space above* the enumext environment set by the above* and above keys.

```
\cs_new_protected:Nn \__enumext_vspace_above:
  {
    \skip_if_eq:nnF
      { \skip_use:c { l__enumext_vspace_above_ \__enumext_level: _skip } }
      { \c_zero_skip }
      {
        \bool_if:cTF { l__enumext_vspace_a_star_ \__enumext_level: _bool }
          {
            \vspace*{ \skip_use:c { l__enumext_vspace_above_ \__enumext_level: _skip } }
          }
          {
            \vspace { \skip_use:c { l__enumext_vspace_above_ \__enumext_level: _skip } }
          }
      }
  }
```

(*End of definition for* __enumext_vspace_above:.)

__enumext_vspace_below: The function __enumext_vspace_below: applies the *vertical space below* the enumext environment set by the below* and below keys.

```
\cs_new_protected:Nn \__enumext_vspace_below:
  {
    \skip_if_eq:nnF
      { \skip_use:c { l__enumext_vspace_below_ \__enumext_level: _skip } }
      { \c_zero_skip }
      {
        \bool_if:cTF { l__enumext_vspace_b_star_ \__enumext_level: _bool }
          {
            \vspace*{ \skip_use:c { l__enumext_vspace_below_ \__enumext_level: _skip } }
          }
          {
            \vspace { \skip_use:c { l__enumext_vspace_below_ \__enumext_level: _skip } }
          }
      }
  }
```

(*End of definition for* __enumext_vspace_below:.)

13.26.2 Functions for above and below keys in keyans

__enumext_vspace_above_v: The function __enumext_vspace_above_v: applies the *vertical space above* the keyans environment set by the above and above* keys.

```
\cs_new_protected:Nn \__enumext_vspace_above_v:
  {
    \skip_if_eq:nnF { \l__enumext_vspace_above_v_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_a_star_v_bool
          {
            \vspace*{ \l__enumext_vspace_above_v_skip }
          }
          { \vspace { \l__enumext_vspace_above_v_skip } }
      }
  }
```

(*End of definition for* __enumext_vspace_above_v:.)

__enumext_vspace_below_v: The function __enumext_vspace_below_v: applies the *vertical space below* the keyans environment set by the below* and below keys.

```
\cs_new_protected:Nn \__enumext_vspace_below_v:
  {
```

```
    \skip_if_eq:nnF { \l__enumext_vspace_below_v_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_b_star_v_bool
          {
            \vspace*{ \l__enumext_vspace_below_v_skip }
          }
          { \vspace { \l__enumext_vspace_below_v_skip } }
      }
  }
```

(*End of definition for* `\__enumext_vspace_below_v:`.)

13.26.3 Functions for `above` and `below` keys in `enumext*` keyans*

`\__enumext_vspace_above_vii:`
`\__enumext_vspace_above_viii:`

The functions `\__enumext_vspace_above_vii:` and `\__enumext_vspace_above_viii:` apply the *vertical space above* the `enumext*` and `keyans*` environments set by the `above` and `above*` keys.

```
\cs_new_protected:Nn \__enumext_vspace_above_vii:
  {
    \skip_if_eq:nnF { \l__enumext_vspace_above_vii_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_a_star_vii_bool
          {
            \vspace*{ \l__enumext_vspace_above_vii_skip }
          }
          { \vspace { \l__enumext_vspace_above_vii_skip } }
      }
  }
\cs_new_protected:Nn \__enumext_vspace_above_viii:
  {
    \skip_if_eq:nnF { \l__enumext_vspace_above_viii_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_a_star_viii_bool
          {
            \vspace*{ \l__enumext_vspace_above_viii_skip }
          }
          { \vspace { \l__enumext_vspace_above_viii_skip } }
      }
  }
```

(*End of definition for* `\__enumext_vspace_above_vii:` *and* `\__enumext_vspace_above_viii:`.)

`\__enumext_vspace_below_vii:`
`\__enumext_vspace_below_viii:`

The functions `\__enumext_vspace_below_vii:` and `\__enumext_vspace_below_viii:` apply the *vertical space below* the `enumext*` and `keyans*` environments set by the `below*` and `below` keys.

```
\cs_new_protected:Nn \__enumext_vspace_below_vii:
  {
    \skip_if_eq:nnF { \l__enumext_vspace_below_vii_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_b_star_vii_bool
          {
            \vspace*{ \l__enumext_vspace_below_vii_skip }
          }
          { \vspace { \l__enumext_vspace_below_vii_skip } }
      }
  }
\cs_new_protected:Nn \__enumext_vspace_below_viii:
  {
    \skip_if_eq:nnF { \l__enumext_vspace_below_viii_skip } { \c_zero_skip }
      {
        \bool_if:NTF \l__enumext_vspace_b_star_viii_bool
          {
            \vspace*{ \l__enumext_vspace_below_viii_skip }
          }
          { \vspace { \l__enumext_vspace_below_viii_skip } }
      }
  }
```

(*End of definition for* `\__enumext_vspace_below_vii:` *and* `\__enumext_vspace_below_viii:`.)

13.27 Setting `series`, `resume` and `resume*` keys

The `series` key is responsible for the whole process of the `resume` and `resume*` keys. The idea behind this is to be able to absorb the ⟨*keys*⟩ passed to the *optional argument* of the environments `enumext` and `enumext*`, but, discarding some specific ⟨*keys*⟩.

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13.27.1 Definition of variables

\l__enumext_series_name_tl
\l__enumext_resume_series_X_bool
\l__enumext_resume_star_key_X_bool
\g__enumext_resume_last_keys_X_tl

Internal variables used by resume, resume* and series keys (§13.27).

```
\tl_new:N \l__enumext_series_name_tl
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_resume_series_ #1 _bool   }
    \bool_new:c { l__enumext_resume_star_key_ #1 _bool }
    \tl_new:c   { g__enumext_resume_last_keys_ #1 _tl  }
  }
\clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_series_name_tl` *and others.*)

13.27.2 Definition of error messages

unknown-series-starred
unknown-series-standard

Messages used by resume key.

```
\msg_new:nnnn { enumext } { unknown-series-starred }
  {
    The~series~'#1'~for~the~resume~key~does~not~exist~in~the~
    enumext*~environment~\msg_line_context:.
  }
  {
    Define~the~series~with~the~key~'series'~in~a~previous~
    'enumext*'~environment~and~check~the~name.
  }
\msg_new:nnnn { enumext } { unknown-series-standard }
  {
    The~series~'#1'~for~the~resume~key~does~not~exist~at~level~
    \int_use:N \l__enumext_level_int
    \c_space_tl of~enumext~environment~\msg_line_context:.
  }
  {
    Define~the~series~with~the~key~'series'~at~that~level~in~
    a~previous~'enumext'~environment~and~check~the~name.
  }
```

(*End of definition for* `unknown-series-starred` *and* `unknown-series-standard`.)

13.27.3 Definition of keys for series, resume and resume*

series
resume
resume*

Defines the keys series, resume and resume* for the *"all levels"* of enumext and enumext*. Both keys do nothing while \printkeyans is running, otherwise the *start value* of the environments would be increased when using resume or resume* keys.

In version 1.6 it is allowed to pass the key resume *without value* by means of the command \setenumext, for the correct operation of this, the boolean variable \l__enumext_resume_count_bool set by the key resume *without value* must be set to true to be later processed by the function __enumext_parse_series:n in the definition of the environments enumext and enumext*.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        series  .str_set:N = \l__enumext_series_name_str,
        series  .value_required:n = true,
        resume  .code:n =
          {
            \bool_if:NF \l__enumext_print_keyans_cmd_bool
              {
                \tl_set:Nn \l__enumext_series_name_tl {##1}
                \tl_if_empty:NTF \l__enumext_series_name_tl
                  {
                    \bool_set_true:c { l__enumext_resume_count_ #2 _bool }
                    \bool_set_eq:Nc
                      \l__enumext_resume_count_bool
                      { l__enumext_resume_count_ #2 _bool }
                  }
                  {
                    \__enumext_resume:n {##1}
                  }
              }
```

```
      },
    resume* .code:n =
      {
        \bool_if:NF \l__enumext_print_keyans_cmd_bool
          {
            \bool_set_true:c { l__enumext_resume_count_ #2 _bool }
            \bool_set_eq:Nc
              \l__enumext_resume_count_bool { l__enumext_resume_count_ #2 _bool }
            \bool_set_true:c { l__enumext_resume_star_key_ #2 _bool }
            \__enumext_resume_star:
          }
      },
    resume* .value_forbidden:n = true,
  }
}
\clist_map_inline:nn
  {
    {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv},{enumext*}{vii},
  }
  { \__enumext_tmp:nn #1 }
```

(*End of definition for* `series`, `resume`, *and* `resume*`.)

13.27.4 Internal function to save counter and integer values

__enumext_standard_save_counter:
__enumext_standard_save_counter_aux:
__enumext_starred_save_counter:
__enumext_starred_save_counter_aux:

The `\__enumext_standard_save_counter:` and `\__enumext_starred_save_counter:` functions will save the last counter value to `\g__enumext_series_#1_X_int` with the name given to the key `series={`⟨*series name*⟩`}` if it has been passed, to `\c@ __enumext_resume_X_int` if none of the keys `series`, `resume={`⟨*series name*⟩`}` and `save-ans` has been passed (the case of the key `resume` *without value*), to `\g__enumext_series_#1_X_int` with the name given to the key `resume={`⟨*series name*⟩`}` if it has been passed and, in the *"first level"*, to `\g__enumext_resume_#1_int` with the `{`⟨*store name*⟩`}` if the key `save-ans={`⟨*store name*⟩`}` has been passed.

The variables `\l__enumext_series_name_str` and `\l__enumext_series_name_tl` contain the same `{`⟨*series name*⟩`}` but are executed at different moments, the integer variable with `\l__enumext_series_name_str` sets the value when executing `series={`⟨*series name*⟩`}` and the integer variable with `\l__enumext_series_name_tl` sets the subsequent values when using `resume={`⟨*series name*⟩`}`. This function is passed to the `enumext` environment definition (§13.43) and the `enumext*` environment definition (§13.48).

```
\cs_new_protected:Nn \__enumext_standard_save_counter:
  {
    \bool_if:NTF \g__enumext_standard_bool
      {
        \__enumext_standard_save_counter_aux:
        \int_compare:nNnT { \l__enumext_level_int } = { 1 }
          {
            \int_if_exist:cT { g__enumext_resume_ \l__enumext_store_name_tl _int }
              {
                \int_gset_eq:cN
                  { g__enumext_resume_ \l__enumext_store_name_tl _int } \value{enumXi}
              }
          }
      }
      {
        \__enumext_standard_save_counter_aux:
      }
  }
\cs_new_protected:Nn \__enumext_standard_save_counter_aux:
  {
    \str_if_empty:NF \l__enumext_series_name_str
      {
        \int_gset_eq:cc
          { g__enumext_series_ \l__enumext_series_name_str _ \__enumext_level: _int }
          { c@enumX \__enumext_level: }
      }
    \tl_if_empty:NTF \l__enumext_series_name_tl
      {
        \str_if_empty:NT \l__enumext_series_name_str
          {
            \tl_if_empty:NT \l__enumext_store_name_tl
              {
                \int_gset_eq:cc
```

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```
                    { c@ __enumext_resume_ \__enumext_level: _int }
                    { c@enumX \__enumext_level: }
                }
            }
        }
        {
          \int_if_exist:cT
            { g__enumext_series_ \l__enumext_series_name_tl _ \__enumext_level: _int }
            {
              \int_gset_eq:cc
                { g__enumext_series_ \l__enumext_series_name_tl _ \__enumext_level: _int }
                { c@enumX \__enumext_level: }
            }
        }
    }
\cs_new_protected:Nn \__enumext_starred_save_counter:
    {
      \bool_if:NTF \g__enumext_starred_bool
        {
          \__enumext_starred_save_counter_aux:
          \int_if_exist:cT { g__enumext_resume_ \l__enumext_store_name_tl _int }
            {
              \int_gset_eq:cN
                { g__enumext_resume_ \l__enumext_store_name_tl _int } \value{enumXvii}
            }
        }
        {
          \__enumext_starred_save_counter_aux:
        }
    }
\cs_new_protected:Nn \__enumext_starred_save_counter_aux:
    {
      \str_if_empty:NF \l__enumext_series_name_str
        {
          \int_gset_eq:cN
            { g__enumext_series_ \l__enumext_series_name_str _vii_int } \value{enumXvii}
        }
      \tl_if_empty:NTF \l__enumext_series_name_tl
        {
          \str_if_empty:NT \l__enumext_series_name_str
            {
              \tl_if_empty:NT \l__enumext_store_name_tl
                {
                  \int_gset_eq:cc { c@ __enumext_resume_vii_int } { c@enumXvii }
                }
            }
        }
        {
          \int_if_exist:cT { g__enumext_series_ \l__enumext_series_name_tl _vii_int }
            {
              \int_gset_eq:cN
                { g__enumext_series_ \l__enumext_series_name_tl _vii_int } \value{enumXvii}
            }
        }
    }
```

(*End of definition for* `\__enumext_standard_save_counter:` *and others.*)

13.27.5 Internal function for resume counters

`\__enumext_resume_counter:`

The `\__enumext_resume_counter:` function is executed by the `resume*` key and `resume` key *without value*, only the *"counters"* for the *"levels"* of the environments in which it is executed will be set. If the `save-ans` key is active it will set the *"counter"* according to the value of the integer variable created by that key.

```
\cs_new_protected:Nn \__enumext_resume_counter:
    {
      \cs_set:Nn \__enumext_tmp:n
        {
          \bool_if:cT { l__enumext_resume_count_ \int_to_roman:n {##1} _bool }
            {
              \int_set:cn { l__enumext_start_ \int_to_roman:n {##1} _int }
                {
```

```
                \int_use:c { c@ __enumext_resume_ \int_to_roman:n {##1} _int } + 1
              }
          }
      }
    \int_compare:nNnT { \l__enumext_level_int } > { 0 }
      {
        \bool_lazy_and:nnTF
          { \bool_if_p:N \l__enumext_standard_first_bool }
          { \bool_if_p:N \l__enumext_store_active_bool }
          {
            \int_set:Nn \l__enumext_start_i_int
              {
                \int_use:c { g__enumext_resume_ \l__enumext_store_name_tl _int } + 1
              }
          }
          {
            \int_step_function:nN { \l__enumext_level_int } \__enumext_tmp:n
          }
      }
    \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
      {
        \bool_lazy_and:nnTF
          { \bool_if_p:N \l__enumext_starred_first_bool }
          { \bool_if_p:N \l__enumext_store_active_bool }
          {
            \int_set:Nn \l__enumext_start_vii_int
              {
                \int_use:c { g__enumext_resume_ \l__enumext_store_name_tl _int } + 1
              }
          }
          {
            \bool_if:NT \l__enumext_resume_count_vii_bool
              {
                \int_set:Nn \l__enumext_start_vii_int
                  {
                    \int_use:c { c@ __enumext_resume_vii_int } + 1
                  }
              }
          }
      }
  }
```

(*End of definition for* `\__enumext_resume_counter:`.)

13.27.6 Internal functions for `series` key

`\__enumext_filter_series:n`
`\__enumext_filter_series_key:n`
`\__enumext_filter_series_pair:nn`

The function `\__enumext_filter_series:n` will be in charge of filtering the ⟨*keys*⟩ to be stored, where '`#1`' represents the *optional argument* passed to the environment. This implementation is adapted directly from the code provided by Jonathan P. Spratte (`@Skillmon`) in chat-TeX-SX

```
\cs_new:Nn \__enumext_filter_series:n
  {
    \use:e
      {
        \keyval_parse:NNn
          \__enumext_filter_series_key:n
          \__enumext_filter_series_pair:nn {#1}
      }
  }
```

The function `\__enumext_filter_series_key:n` will be responsible for filtering the ⟨*keys*⟩ that are passed *"without value"* by excluding the `resume`, `resume*`, `reset`, `reset*` and `base-fix` keys.

```
\cs_new:Nn \__enumext_filter_series_key:n
  {
    \str_case:nnF {#1}
      {
        { resume } { } { resume* } { } { reset } { } { reset* } { }
          { base-fix } { }
      }
      { , { \exp_not:n {#1} } }
  }
```

The function __enumext_filter_series_pair:nn will be responsible for filtering the ⟨*keys*⟩ that are passed *"with value"* by excluding the series, resume, start, start*, save-ans and save-key keys.

```
\cs_new:Nn \__enumext_filter_series_pair:nn
  {
    \str_case:nnF {#1}
      {
        { series } { } { resume } { } { start } { }
        { start* } { }  { save-ans } { } { save-key } { }
      }
      { , { \exp_not:n {#1} } = { \exp_not:n {#2} } }
  }
```

(*End of definition for* __enumext_filter_series:n, __enumext_filter_series_key:n, *and* __enumext_filter_series_pair:nn.)

__enumext_save_last_keys:n
__enumext_resume_last_counter:

The function __enumext_save_last_keys:n will be in charge of saving the filtering ⟨*keys*⟩ when the keys series={⟨*series name*⟩} or resume={⟨*series name*⟩} or resume* are NOT active and will save them in the variable \g__enumext_resume_last_keys_X_tl for the enumext environment and in the variable \g__enumext_resume_last_keys_vii_tl for the enumext* environment.

The boolean variable \l__enumext_resume_series_X_bool is set to true by the key resume={⟨*series name*⟩}, the boolean variable \l__enumext_resume_star_key_X_bool is set to true by the key resume*, in this case both variables must be set to false so that they don't override the default filtered ⟨*keys*⟩.

```
\cs_new_protected:Nn \__enumext_save_last_keys:n
  {
    \int_compare:nNnT { \l__enumext_level_int } > { 0 }
      {
        \bool_if:cF { l__enumext_resume_series_ \__enumext_level: _bool }
          {
            \bool_if:cF { l__enumext_resume_star_key_ \__enumext_level: _bool }
              {
                \tl_gclear:c { g__enumext_resume_last_keys_ \__enumext_level: _tl }
                \tl_gset:ce
                  { g__enumext_resume_last_keys_ \__enumext_level: _tl }
                  { \__enumext_filter_series:n {#1} }
              }
          }
      }
    \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
      {
        \bool_if:NF \l__enumext_resume_series_vii_bool
          {
            \tl_gclear:N \g__enumext_resume_last_keys_vii_tl
            \tl_gset:Ne \g__enumext_resume_last_keys_vii_tl
              { \__enumext_filter_series:n {#1} }
          }
      }
  }
```

The __enumext_resume_last_counter: function will be in charge of setting the *"counters"* when the keys series={⟨*series name*⟩} or resume={⟨*series name*⟩} are NOT active and the resume key is being used *without value* either in the *optional argument* of the environments or through the \setenumext command.

The boolean variable \l__enumext_resume_count_bool is set to true by the keys resume *without value* and resume*; and set to false by the keys start and start* (§13.15).

```
\cs_new_protected:Nn \__enumext_resume_last_counter:
  {
    \bool_lazy_and:nnT
      { \bool_if_p:N \l__enumext_resume_count_bool }
      { \tl_if_empty_p:N \l__enumext_series_name_tl }
      {
        \__enumext_resume_counter:
      }
  }
```

(*End of definition for* __enumext_save_last_keys:n *and* __enumext_resume_last_counter:.)

__enumext_parse_series:n

The __enumext_parse_series:n function handled by the series key will be responsible for *storing* the *filtered* ⟨*keys*⟩ from the *optional arguments* of the enumext and enumext* environments for the resume and resume* keys. If the series key is NOT active it will call the

__enumext_save_last_keys:n function to *store* the *filtered* ⟨*keys*⟩ that will be used by the resume* key and then the __enumext_resume_last_counter: function used by the resume key *without value* if it is active, otherwise *store* the *filtered* ⟨*keys*⟩ in the global variable \g__enumext_series_#1_X_tl along with the creation of the integer variable \g__enumext_series_#1_X_int used by the resume key *with value*.

This function is passed to the function __enumext_parse_keys:n in the enumext environment definition (§13.43) and to the function __enumext_parse_keys_vii:n in the enumext* environment definition (§13.48).

```
\cs_new_protected:Nn \__enumext_parse_series:n
  {
    \str_if_empty:NTF \l__enumext_series_name_str
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 0 }
          {
            \__enumext_save_last_keys:n {#1}
            \__enumext_resume_last_counter:
          }
        \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
          {
            \__enumext_save_last_keys:n {#1}
            \__enumext_resume_last_counter:
          }
      }
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 0 }
          {
            \tl_gclear_new:c
              { g__enumext_series_ \l__enumext_series_name_str _ \__enumext_level: _tl }
            \tl_gset:ce
              { g__enumext_series_ \l__enumext_series_name_str _ \__enumext_level: _tl }
              { \__enumext_filter_series:n {#1} }
            \int_if_exist:cF
              { g__enumext_series_ \l__enumext_series_name_str _ \__enumext_level: _int }
              {
                \int_new:c
              { g__enumext_series_ \l__enumext_series_name_str
                _ \__enumext_level: _int }
              }
          }
        \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
          {
            \tl_gclear_new:c { g__enumext_series_ \l__enumext_series_name_str _vii_tl }
            \tl_gset:ce
              { g__enumext_series_ \l__enumext_series_name_str _vii_tl }
              { \__enumext_filter_series:n {#1} }
            \int_if_exist:cF { g__enumext_series_ \l__enumext_series_name_str _vii_int }
              {
                \int_new:c { g__enumext_series_ \l__enumext_series_name_str _vii_int }
              }
          }
      }
  }
```

(*End of definition for* __enumext_parse_series:n.)

13.27.7 Internal functions for resume key with value

__enumext_resume:n

The function __enumext_resume:n will handle the *argument* {⟨*series name*⟩} passed to the resume key in enumext and enumext* environments. First it checks if the global variable \g__enumext_series_#1_X_tl exists; if so, it calls the function __enumext_resume_series:n and passes the ⟨*keys*⟩ stored in \g__enumext_series_#1_X_tl to the environments, otherwise it returns an error.

```
\cs_new_protected:Nn \__enumext_resume:n
  {
    \int_compare:nNnT { \l__enumext_level_int } > { 0 }
      {
        \tl_if_exist:cTF { g__enumext_series_ \tl_to_str:n {#1} _ \__enumext_level: _tl }
          {
            \__enumext_resume_series:n {#1}
            \keys_set:ev { enumext /
              level-\int_use:N \l__enumext_level_int }
              { g__enumext_series_ \tl_to_str:n {#1} _ \__enumext_level: _tl }
          }
```

```
2155            {
2156              \msg_error:nnn { enumext } { unknown-series-standard } {#1}
2157            }
2158        }
2159      \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
2160        {
2161          \tl_if_exist:cTF { g__enumext_series_ \tl_to_str:n {#1} _vii_tl }
2162            {
2163              \__enumext_resume_series:n {#1}
2164              \keys_set:nv { enumext / enumext* }
2165                { g__enumext_series_ \tl_to_str:n {#1} _vii_tl }
2166            }
2167            {
2168              \msg_error:nnn { enumext } { unknown-series-starred } {#1}
2169            }
2170        }
2171    }
```

(*End of definition for* `\__enumext_resume:n`.)

`\__enumext_resume_series:n`
`\__enumext_resume_integer_series:`

The function `\__enumext_resume_series:n` will set the variable `\l__enumext_resume_series_X_bool` to `true` and pass the {⟨*argument*⟩} to the variable `\l__enumext_series_name_tl` then call the function `\__enumext_resume_integer_series:`.

```
2172 \cs_new_protected:Nn \__enumext_resume_series:n
2173   {
2174     \int_compare:nNnT { \l__enumext_level_int } > { 0 }
2175       {
2176         \bool_set_true:c { l__enumext_resume_series_ \__enumext_level: _bool }
2177         \tl_clear:N \l__enumext_series_name_tl
2178         \tl_set:Nn \l__enumext_series_name_tl {#1}
2179         \__enumext_resume_integer_series:
2180       }
2181     \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
2182       {
2183         \bool_set_true:N \l__enumext_resume_series_vii_bool
2184         \tl_clear:N \l__enumext_series_name_tl
2185         \tl_set:Nn \l__enumext_series_name_tl {#1}
2186         \__enumext_resume_integer_series:
2187       }
2188   }
```

The function `\__enumext_resume_integer_series:` will be executed when the `resume`={⟨*series name*⟩} key is active, setting the *start value* for the *"counter"* of the *"current level"* of the environments in which it is run according to the value of the *"integer variables"* created by the `series` key. If the `save-ans` key is active it will set the *start value* for the *"counter"* according to the value of the integer variable created by that key.

```
2189 \cs_new_protected:Nn \__enumext_resume_integer_series:
2190   {
2191     \cs_set:Nn \__enumext_tmp:n
2192       {
2193         \int_if_exist:cT { g__enumext_series_ \l__enumext_series_name_tl _
2194           \int_to_roman:n {##1} _int }
2195           {
2196             \int_set:cn { l__enumext_start_ \int_to_roman:n {##1} _int }
2197               {
2198                 \int_use:c { g__enumext_series_ \l__enumext_series_name_tl _
2199                   \int_to_roman:n {##1} _int } + 1
2200               }
2201           }
2202       }
2203     \int_compare:nNnT { \l__enumext_level_int } > { 0 }
2204       {
2205         \bool_lazy_and:nnTF
2206           { \bool_if_p:N \l__enumext_standard_first_bool }
2207           { \bool_if_p:N \l__enumext_store_active_bool }
2208           {
2209             \int_set:Nn \l__enumext_start_i_int
2210               {
2211                 \int_use:c { g__enumext_resume_ \l__enumext_store_name_tl _int } + 1
2212               }
2213           }
```

```
2214            {
2215              \int_step_function:nN { \l__enumext_level_int } \__enumext_tmp:n
2216            }
2217        }
2218      \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
2219        {
2220          \bool_lazy_and:nnTF
2221            { \bool_if_p:N \l__enumext_starred_first_bool }
2222            { \bool_if_p:N \l__enumext_store_active_bool }
2223            {
2224              \int_set:Nn \l__enumext_start_vii_int
2225                {
2226                  \int_use:c { g__enumext_resume_ \l__enumext_store_name_tl _int } + 1
2227                }
2228            }
2229            {
2230              \int_set:Nn \l__enumext_start_vii_int
2231                {
2232                  \int_use:c { g__enumext_series_ \l__enumext_series_name_tl _vii_int } + 1
2233                }
2234            }
2235        }
2236    }
```

(*End of definition for* `\__enumext_resume_series:n` *and* `\__enumext_resume_integer_series:`.)

13.27.8 Internal function for `resume*` key

`\__enumext_resume_star:`

The function `\__enumext_resume_star:` will handle the `resume*` key in the `enumext` and `enumext*` environments. This function will execute the filtered ⟨*keys*⟩ in the last one and will continue with the numbering and ⟨*keys*⟩ according to the last execution of the environment `enumext` or `enumext*` in which the keys `resume`={⟨*series name*⟩} or `series`={⟨*series name*⟩} were NOT active.

```
2237 \cs_new_protected:Nn \__enumext_resume_star:
2238   {
2239     \cs_set:Nn \__enumext_tmp:n
2240       {
2241         \tl_if_empty:cTF { g__enumext_resume_last_keys_ \int_to_roman:n {##1} _tl }
2242           {
2243             \__enumext_resume_counter:
2244           }
2245           {
2246             \__enumext_resume_counter:
2247             \keys_set:ev
2248               { enumext / level-\int_use:N \l__enumext_level_int }
2249               { g__enumext_resume_last_keys_ \int_to_roman:n {##1} _tl }
2250           }
2251       }
2252     \int_compare:nNnT { \l__enumext_level_int } > { 0 }
2253       {
2254         \int_step_function:nN { \l__enumext_level_int } \__enumext_tmp:n
2255       }
2256     \int_compare:nNnT { \l__enumext_level_h_int } = { 1 }
2257       {
2258         \tl_if_empty:NTF \g__enumext_resume_last_keys_vii_tl
2259           {
2260             \__enumext_resume_counter:
2261           }
2262           {
2263             \__enumext_resume_counter:
2264             \keys_set:nV { enumext / enumext* } \g__enumext_resume_last_keys_vii_tl
2265           }
2266       }
2267   }
```

(*End of definition for* `\__enumext_resume_star:`.)

13.28 The `\resetenumext` command

Sometimes it is necessary to be able to reset the *"counters"* of the environments according to some value, for example `\chapter`. Since *"internal counters"* are used for the `resume` and `resume*` keys which set the *start value*, but are not accessible by the user, it is necessary to provide a public command for this. This implementation is an adaptation of the answers given by Clea F. Rees (`@cfr`) and Jonathan P. Spratte (`@Skillmon`) in Correct implementation of optional argument (comma-separated) in expl3.

out-of-range Message used by \resetenumext command.

```
\msg_new:nnnn { enumext } { out-of-range }
  {
    The~number~must~be~exactly~1,~2,~3~or~4.
  }
  {
    Received:~'#1'.
  }
```

(*End of definition for* `out-of-range`.)

__enumext_standard_reset:nn
__enumext_starred_reset:n
__enumext_reset_count_resume:nn
__enumext_reset_count_resume:en
__enumext_reset_count_resume_all:n
__enumext_reset_count_resume_levels:n
Internal functions used by the \resetenumext command.

```
\cs_new_protected:Npn \__enumext_standard_reset:nn #1 %#2
  {
    \__enumext_reset_count_resume:en { \int_to_roman:n {#1} } %{#2}
  }
\cs_new_protected:Nn \__enumext_starred_reset:n
  {
    \__enumext_reset_count_resume:nn { vii } {#1}
  }
\cs_new_protected:Nn \__enumext_reset_count_resume:nn
  {
    \counterwithin*{enumX #1}{#2}
    \counterwithin*{__enumext_resume_ #1 _int}{#2}
  }
\cs_generate_variant:Nn \__enumext_reset_count_resume:nn { e }
\cs_new_protected:Nn \__enumext_reset_count_resume_all:n
  {
    \clist_map_inline:nn { i,ii,iii,iv,vii }
      {
        \__enumext_reset_count_resume:nn {##1} {#1}
      }
  }
\cs_new_protected:Nn \__enumext_reset_count_resume_levels:n
  {
    \clist_map_inline:nn { i,ii,iii,iv }
      {
        \__enumext_reset_count_resume:nn {##1} {#1}
      }
  }
```

(*End of definition for* `\__enumext_standard_reset:nn` *and others.*)

\resetenumext The \resetenumext command *"resets"* the *start value* of the *"counters"* for the enumext and enumext* environments along with the *"internal counters"* used by the keys resume *without value* and resume* according to the value of {⟨*some counter*⟩}. It accepts a *starred argument* '*' in '#1', an optional argument in '#2' with the level from 1 to 4 or the character '*', and the mandatory {⟨*some counter*⟩} in '#3'.

```
\NewDocumentCommand \resetenumext { s o m }
  {
    \bool_if:nTF {#1}
      {
        \__enumext_reset_count_resume_all:n {#3}
      }
      {
        \tl_if_novalue:nTF {#2}
          {
            \__enumext_reset_count_resume_levels:n {#3}
          }
          {
            \str_if_eq:nnTF {#2} { * }
              { \__enumext_starred_reset:n {#3} }
              {
                \bool_lazy_and:nnTF
                  { \int_compare_p:nNn {#2} > { 0 } }
                  { \int_compare_p:nNn {#2} < { 5 } }
                  { \__enumext_standard_reset:nn {#2} {#3} }
                  {
                    \msg_error:nne { enumext } { out-of-range }
                      { \int_eval:n {#2} }
                  }
```

```
            }
        }
    }
}
```

(*End of definition for* `\resetenumext`. *This function is documented on page* 12.)

13.29 The `reset` and `reset*` keys

The `\resetenumext` command does not work, for example, after an unnumbered chapter, so it is preferable to provide a pair of ⟨*keys*⟩ that adjust the internal variables if necessary.

`reset` `reset*`

Defines the keys `reset` and `reset*` for the *"all levels"* of `enumext` and `enumext*`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / #1 }
      {
        reset  .code:n = { \__enumext_standard_reset_key: },
        reset  .value_forbidden:n = true,
        reset* .code:n = { \__enumext_standard_reset_key_star: },
        reset* .value_forbidden:n = true,
      }
  }
\clist_map_inline:nn {level-1, level-2, level-3, level-4} { \__enumext_tmp:n {#1} }
\keys_define:nn { enumext / enumext* }
  {
    reset  .code:n = { \__enumext_starred_reset_key: },
    reset  .value_forbidden:n = true,
    reset* .code:n = { \__enumext_starred_reset_key: },
    reset* .value_forbidden:n = true,
  }
```

(*End of definition for* `reset` *and* `reset*`.)

13.29.1 Internal functions for `reset` and `reset*` keys

`\__enumext_standard_reset_key:` `\__enumext_standard_reset_key_star:` `\__enumext_starred_reset_key:`

The function `\__enumext_standard_reset_key:` will be handled by the `reset` key and will *"reset"* the counter `\c@ __enumext_resume_X_int` to *"zero"* according to the *level* at which it is executed within the `enumext` environment.

```
\cs_new_protected:Nn \__enumext_standard_reset_key:
  {
    \int_compare:nNnT { \l__enumext_level_int } > { 0 }
      {
        \int_if_exist:cT { c@ __enumext_resume_ \int_to_roman:n { \l__enumext_level_int }
          _int }
          {
            \int_gzero:c { c@ __enumext_resume_ \int_to_roman:n { \l__enumext_level_int }
              _int }
          }
      }
  }
```

The function `\__enumext_standard_reset_key_star:` will be handled by the `reset*` key and will *"reset"* the counters `\c@ __enumext_resume_X_int` to *"zero"* from the *level* at which it is executed within the `enumext` environment to the *lower levels*.

```
\cs_new_protected:Nn \__enumext_standard_reset_key_star:
  {
    \cs_set:Nn \__enumext_tmp:n
      {
        \int_if_exist:cT { c@ __enumext_resume_ \int_to_roman:n {##1} _int }
          {
            \int_gzero:c { c@ __enumext_resume_ \int_to_roman:n {##1} _int }
          }
      }
    \int_compare:nNnT { \l__enumext_level_int } > { 0 }
      {
        \int_step_function:nnN { \l__enumext_level_int } { 4 } \__enumext_tmp:n
      }
  }
```

The function __enumext_starred_reset_key: will be handled by reset keys and reset* will *"reset"* the counter \c@ __enumext_resume_vii_int to *"zero"* when executed in the enumext* environment.

```
\cs_new_protected:Nn \__enumext_starred_reset_key:
  {
    \int_gzero:c { c@ __enumext_resume_vii_int }
  }
```

(*End of definition for* __enumext_standard_reset_key:, __enumext_standard_reset_key_star:, *and* __enumext_starred_reset_key:.)

13.30 Setting save-ans, check-ans and no-store keys

The key save-ans is directly associated with the keys check-ans, no-store, resume and resume*, this will activate the entire *"storage system"* in the enumext package.

13.30.1 Definition of error messages

save-ans-empty Message used by save-ans key.

```
\msg_new:nnnn { enumext } { save-ans-empty }
  {
    Key~'save-ans'~needs~a~value~in~'#1'~\msg_line_context:.
  }
  {
    Give~a~name~to~the~storage,~for~example~'save-ans=name'.
  }
```

(*End of definition for* save-ans-empty.)

missing-starred
many-starred
Messages used by the internal system to check for *"starred"* \item* and \anspic* commands.

```
\msg_new:nnn { enumext } { missing-starred }
  {
    Missing~'\c_backslash_str #1*'~#2.
  }
\msg_new:nnn { enumext } { many-starred }
  {
    Many~'\c_backslash_str #1*'~#2.
  }
```

(*End of definition for* missing-starred *and* many-starred.)

13.30.2 Definition of messages for the storage system

These messages are not error messages, they report to the .log file what the *"storage system"* is doing.

save-ans-log
save-ans-log-hook
Messages written to the .log file when the save-ans key starts and stops.

```
\msg_new:nnn { enumext } { save-ans-log }
  {
    Start~'#1'~with~'save-ans=#2'~\msg_line_context:.
  }
\msg_new:nnn { enumext } { save-ans-log-hook }
  {
    Stop~'#1'~with~'save-ans=#2'~\msg_line_context:.
  }
```

(*End of definition for* save-ans-log *and* save-ans-log-hook.)

store-prop
store-seq
store-int
Messages written to the .log file when the *prop list*, *sequence* and integer variables used by the save-ans key are created.

```
\msg_new:nnn { enumext } { store-prop }
  {
    Creating~\c_backslash_str g__enumext_ #1 _prop~\msg_line_context:.
  }
\msg_new:nnn { enumext } { store-seq }
  {
    Creating~\c_backslash_str g__enumext_ #1 _seq~\msg_line_context:.
  }
\msg_new:nnn { enumext } { store-int }
  {
    Creating~\c_backslash_str g__enumext_resume_ #1 _int~\msg_line_context:.
  }
```

(*End of definition for* `store-prop`, `store-seq`, *and* `store-int`.)

items-same-answer
item-greater-answer
item-less-answer

Messages used by the internal system to check answer used by `check-ans` key.

```
\msg_new:nnn { enumext } { items-same-answer }
  {
    Answers~in~'#1'~(#2):~OK,~items~=~answers.\\
    Started~#3~and~closed~\msg_line_context:.
  }
\msg_new:nnn { enumext } { item-greater-answer }
  {
    Answers~in~'#1'~(#2):~NOT~OK,~items~>~answers.\\
    Started~#3~and~closed~\msg_line_context:.
  }
\msg_new:nnn { enumext } { item-less-answer }
  {
    Answers~in~'#1'~(#2):~NOT~OK,~items~<~answers.\\
    Started~#3~and~closed~\msg_line_context:.
  }
```

(*End of definition for* `items-same-answer`, `item-greater-answer`, *and* `item-less-answer`.)

13.30.3 Setting save-ans key

save-ans

Defines the key `save-ans` only for the *"first level"* of `enumext` and `enumext*`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / #1 }
      {
        save-ans .code:n = { \__enumext_storing_set:n {##1} },
        save-ans .value_required:n = true,
      }
  }
\clist_map_inline:nn { level-1, enumext* } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `save-ans`.)

13.30.4 Internal functions for save-ans key

__enumext_start_save_ans_msg:
__enumext_stop_save_ans_msg:

The functions `\__enumext_start_save_ans_msg:` and `\__enumext_stop_save_ans_msg:` will write in the `.log` file the environment in which the `save-ans` key was executed along with the line at the beginning and end of it. The function `\__enumext_start_save_ans_msg:` will be passed to `\__enumext_storing_set:n` and the function `\__enumext_stop_save_ans_msg:` will be passed to the function `\__enumext_execute_after_env:`.

```
\cs_new_protected:Nn \__enumext_start_save_ans_msg:
  {
    \msg_info:nnVV { enumext } { save-ans-log }
      \g__enumext_envir_name_tl \l__enumext_store_name_tl
  }
\cs_new_protected:Nn \__enumext_stop_save_ans_msg:
  {
    \msg_info:nnVV { enumext } { save-ans-log-hook }
      \g__enumext_envir_name_tl \g__enumext_store_name_tl
  }
```

(*End of definition for* `\__enumext_start_save_ans_msg:` *and* `\__enumext_stop_save_ans_msg:`.)

__enumext_storing_set:n
__enumext_storing_exec:

The function `\__enumext_storing_set:n` first passes the value of the `save-ans` key to the variable `\l__enumext_store_name_tl` which contains the {⟨*store name*⟩} of the *sequence* and *prop list* to be used. If `\l__enumext_store_name_tl` is *empty* it returns an error message, otherwise it returns the appropriate message `\__enumext_start_save_ans_msg:` and proceeds to execute the function `\__enumext_storing_exec:` for `enumext` and `enumext*` environments.

```
\cs_new_protected:Nn \__enumext_storing_set:n
  {
    \tl_set:Ne \l__enumext_store_name_tl {#1}
    \tl_if_empty:NTF \l__enumext_store_name_tl
      {
        \bool_lazy_or:nnT
          { \l__enumext_standard_first_bool } { \l__enumext_starred_first_bool }
          {
```

```
2455              \msg_error:nnV { enumext } { save-ans-empty } \g__enumext_envir_name_tl
2456            }
2457        }
2458        {
2459          \bool_lazy_or:nnT
2460            { \l__enumext_standard_first_bool } { \l__enumext_starred_first_bool }
2461            {
2462              \__enumext_start_save_ans_msg:
2463              \__enumext_storing_exec:
2464            }
2465        }
2466    }
```

The function `\__enumext_storing_exec:` will set to true the variable `\l__enumext_store_active_bool` which activates the use of the `\anskey` command and the `anskey*`, `keyans`, `keyans*` and `keyanspic` environments and will set to `true` the variable `\l__enumext_check_answers_bool` used for internal checking answers mechanism set by the `check-ans` and `no-store` keys, and copies the {⟨*store name*⟩} into the variable `\g__enumext_store_name_tl`.

```
2467 \cs_new_protected:Nn \__enumext_storing_exec:
2468   {
2469     \bool_set_true:N \l__enumext_store_active_bool
2470     \bool_set_true:N \l__enumext_check_answers_bool
2471     \tl_gset:NV \g__enumext_store_name_tl \l__enumext_store_name_tl
```

The *prop list* `\g__enumext_series_#1_prop` and the *sequence* `\g__enumext_series_#1_seq` will be created globally to *"store content"* in case they do not exist together with the integer variable `\g__enumext_series_#1_int` used by the keys `resume` and `resume*`.

```
2472     \prop_if_exist:cF { g__enumext_ \l__enumext_store_name_tl _prop }
2473       {
2474         \msg_info:nnV { enumext } { store-prop } \l__enumext_store_name_tl
2475         \prop_new:c { g__enumext_ \l__enumext_store_name_tl _prop }
2476       }
2477     \seq_if_exist:cF { g__enumext_ \l__enumext_store_name_tl _seq }
2478       {
2479         \msg_info:nnV { enumext } { store-seq } \l__enumext_store_name_tl
2480         \seq_new:c { g__enumext_ \l__enumext_store_name_tl _seq }
2481       }
2482     \int_if_exist:cF { g__enumext_resume_ \l__enumext_store_name_tl _int }
2483       {
2484         \msg_info:nnV { enumext } { store-int } \l__enumext_store_name_tl
2485         \int_new:c { g__enumext_resume_ \l__enumext_store_name_tl _int }
2486       }
2487   }
```

(*End of definition for* `\__enumext_storing_set:n` *and* `\__enumext_storing_exec:`.)

13.30.5 The check answer mechanism

The internal mechanism for *"checking answers"* follows this logic:

> If the line begins with `\item` or `\item*` and does NOT *open a nested environment*, each `\item` or `\item*` must contain a *single* execution of the `\anskey` command, i.e. the counter of the executions of the `\anskey` command must be equal to the counter associated with the sum of executions of `\item` and `\item*`.
>
> If the line begins with `\item` or `\item*` and *opens a nested environment* each `\item` or `\item*` in the nested environment must have a *single* execution of the `\anskey` command and the counter associated to the sum of `\item` and `\item*` executions must be decremented by *"one"* to maintain equality.

In order for the mechanism for the check-answer to work (not counting `keyans`, `keyans*` and `keyanspic`) it is necessary to:

1. Keep track of the total number of `\item` and `\item*` (enumerated) that appear within the environment including the nested levels.
2. Keep track of the total number of `\item` and `\item*` (enumerated) that appear per level of nesting.
3. Keep track of the number of times the environment nests.

The integer variable `\g__enumext_item_number_int`, associated to the sum of each `\item` and `\item*` in the environment, must match the integer variable `\g__enumext_item_anskey_int`, associated to the execution of the command `\anskey`. The cases are analyzed below:

a) If the list only has one level the number of \item + \item* = \anskey
b) If the list has *nested levels*, for each level of nesting the count is decremented by one (for the \item or \item* that opens the nest) so that the account remains the same.

With keyans, keyans* and keyanspic it is enough to increase in one the integer of \anskey. The integers created must be global if they are not lost in the interior levels of nesting and to execute the test a *"hook"* function is used after closing the *first level* of the environment.

13.30.6 Setting check-ans and no-store keys

check-ans
no-store

Defines the keys check-ans and no-store for all levels of enumext and enumext* environments.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / #1 }
      {
        check-ans .bool_set:N = \l__enumext_check_ans_key_bool,
        check-ans .initial:n = false,
        check-ans .value_required:n = true,
        no-store  .code:n =
          {
            \bool_set_false:N \l__enumext_check_answers_bool
            \bool_set_false:N \l__enumext_check_ans_key_bool
          },
        no-store  .value_forbidden:n = true,
      }
  }
\clist_map_inline:nn
  {
    level-1, level-2, level-3, level-4, enumext*
  }
  { \__enumext_tmp:n {#1} }
```

(*End of definition for* check-ans *and* no-store.)

13.30.7 Set-up check answer mechanism

__enumext_check_ans_active:
__enumext_check_ans_level:

The function __enumext_check_ans_active: first checks if the key save-ans is active, that is, if the variable \l__enumext_store_name_tl is not empty. If so, it checks the state of the variable \l__enumext_check_answers_bool, handled by the key no-store. Only if it is true, i.e. the key no-store is not active, it executes the function __enumext_check_ans_level:.

```
\cs_new_protected:Nn \__enumext_check_ans_active:
  {
    \tl_if_empty:NF \l__enumext_store_name_tl
      {
        \bool_if:NT \l__enumext_check_answers_bool
          {
            \__enumext_check_ans_level:
          }
      }
  }
```

The function __enumext_check_ans_level: will decrement by *"one"* the value of the variable \g__enumext_item_number_int which keeps track of the executions of \item and \item* for each level of nesting of the environment enumext, taking into account whether it is nested within enumext* or the opposite and set \l__enumext_item_number_bool to false.

```
\cs_new_protected:Nn \__enumext_check_ans_level:
  {
    \int_case:nn { \l__enumext_level_int }
      {
        { 1 }
          {
            \bool_lazy_all:nT
              {
                { \bool_if_p:N \g__enumext_starred_bool }
                { \int_compare_p:nNn { \l__enumext_level_h_int } = { 1 } }
              }
              {
                \int_gdecr:N \g__enumext_item_number_int
                \bool_set_false:N \l__enumext_item_number_bool
              }
```

```
      }
    { 2 }
      {
        \int_gdecr:N \g__enumext_item_number_int
        \bool_set_false:N \l__enumext_item_number_bool
      }
    { 3 }
      {
        \int_gdecr:N \g__enumext_item_number_int
        \bool_set_false:N \l__enumext_item_number_bool
      }
    { 4 }
      {
        \int_gdecr:N \g__enumext_item_number_int
        \bool_set_false:N \l__enumext_item_number_bool
      }
  }
```

This is executed only if `enumext*` is nested in the *"first level"* of `enumext`, for the rest of the cases the value of `\g__enumext_item_number_int` is already decreased.

```
  \int_case:nn { \l__enumext_level_h_int }
    {
      { 1 }
        {
          \bool_lazy_all:nT
            {
              { \bool_if_p:N \g__enumext_standard_bool }
              { \int_compare_p:nNn { \l__enumext_level_int } = { 1 } }
            }
            {
              \int_gdecr:N \g__enumext_item_number_int
              \bool_set_false:N \l__enumext_item_number_bool
            }
        }
    }
}
```

(*End of definition for* `\__enumext_check_ans_active:` *and* `\__enumext_check_ans_level:`.)

`\__enumext_check_ans_key_hook:`

Only if the key `check-ans` is active, the function `\__enumext_check_ans_key_hook:` will *export* the status of the local variable `\l__enumext_check_ans_key_bool` to the global variable `\g__enumext_check_ans_key_bool`.

```
\cs_new_protected:Nn \__enumext_check_ans_key_hook:
  {
    \bool_lazy_and:nnT
      { \bool_if_p:N \l__enumext_check_ans_key_bool }
      { \bool_if_p:N \g__enumext_standard_bool }
      {
        \bool_gset_true:N \g__enumext_check_ans_key_bool
      }
    \bool_lazy_and:nnT
      { \bool_if_p:N \l__enumext_check_ans_key_bool }
      { \bool_if_p:N \g__enumext_starred_bool }
      {
        \bool_gset_true:N \g__enumext_check_ans_key_bool
      }
  }
```

(*End of definition for* `\__enumext_check_ans_key_hook:`.)

`\__enumext_item_answer_diff:`

The function `\__enumext_item_answer_diff:` will be passed to `\__enumext_execute_after_env:` and sets the value of the integer `\g__enumext_item_answer_diff_int`. This value is used by the function `\__enumext_check_ans_show:` for the key `save-ans` and by `\__enumext_check_ans_log:` for the internal *"check answer"* mechanism.

```
\cs_new_protected:Nn \__enumext_item_answer_diff:
  {
    \int_gset:Nn \g__enumext_item_answer_diff_int
      {
        \int_sign:n { \g__enumext_item_number_int - \g__enumext_item_anskey_int }
      }
  }
```

(*End of definition for* `\__enumext_item_answer_diff:`.)

`\__enumext_check_ans_show:`
`\__enumext_check_ans_msg_less:`
`\__enumext_check_ans_msg_same_ok:`
`\__enumext_check_ans_msg_greater:`

The function `\__enumext_check_ans_show:` will be executed within `\__enumext_execute_after_env:` when the key `check-ans` is active, that is, when `\g__enumext_check_ans_key_bool` is `true`, and will return the appropriate message according to the value of `\g__enumext_item_answer_diff_int` set by `\__enumext_item_answer_diff:`.

```
\cs_new_protected:Nn \__enumext_check_ans_show:
  {
    \int_case:nn { \g__enumext_item_answer_diff_int }
      {
        { -1 }{ \__enumext_check_ans_msg_less:    }
        {  0 }{ \__enumext_check_ans_msg_same_ok: }
        {  1 }{ \__enumext_check_ans_msg_greater: }
      }
  }
\cs_new_protected:Nn \__enumext_check_ans_msg_less:
  {
    \msg_warning:nneee { enumext } { item-less-answer } { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
\cs_new_protected:Nn \__enumext_check_ans_msg_same_ok:
  {
    \msg_info:nneee { enumext } { items-same-answer } { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
\cs_new_protected:Nn \__enumext_check_ans_msg_greater:
  {
    \msg_warning:nneee { enumext } { item-greater-answer }
      { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
```

(*End of definition for* `\__enumext_check_ans_show:` *and others.*)

`\__enumext_check_ans_log:`
`\__enumext_check_ans_log_msg_less:`
`\__enumext_check_ans_log_msg_same_ok:`
`\__enumext_check_ans_log_msg_greater:`

The function `\__enumext_check_ans_log:` will be executed within `\__enumext_execute_after_env:` when the key `check-ans` is not active, that is, when `\g__enumext_check_ans_key_bool` is `false`, and will write in the log the appropriate message according to the value of `\g__enumext_item_answer_diff_int` set by `\__enumext_item_answer_diff:`.

```
\cs_new_protected:Nn \__enumext_check_ans_log:
  {
    \int_case:nn { \g__enumext_item_answer_diff_int }
      {
        { -1 }{ \__enumext_check_ans_log_msg_less:    }
        {  0 }{ \__enumext_check_ans_log_msg_same_ok: }
        {  1 }{ \__enumext_check_ans_log_msg_greater: }
      }
  }
\cs_new_protected:Nn \__enumext_check_ans_log_msg_less:
  {
    \msg_info:nneee { enumext } { item-less-answer } { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
\cs_new_protected:Nn \__enumext_check_ans_log_msg_same_ok:
  {
    \msg_info:nneee { enumext } { items-same-answer }  { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
\cs_new_protected:Nn \__enumext_check_ans_log_msg_greater:
  {
    \msg_info:nneee { enumext } { item-greater-answer } { \g__enumext_store_name_tl }
      { \g__enumext_envir_name_tl } { \g__enumext_start_line_tl }
  }
```

(*End of definition for* `\__enumext_check_ans_log:` *and others.*)

13.30.8 Check for `\item*` and `\anspic*` commands

`\__enumext_check_starred_cmd:n`

The function `\__enumext_check_starred_cmd:n` performs an *extra check* for the `keyans`, `keyans*` and `keyanspic` environments. Unlike the *check* executed by `check-ans` key this one is not controlled by any key, it is intended to prevent the forgetting of `\item*` or `\anspic*` in these environments.

```
\cs_new_protected:Nn \__enumext_check_starred_cmd:n
```

```
  {
    \int_compare:nNnT
      { \g__enumext_check_starred_cmd_int } = { 0 }
      {
        \msg_warning:nnnV
          { enumext } { missing-starred }{#1} \l__enumext_check_start_line_env_tl
      }
    \int_compare:nNnT
      { \g__enumext_check_starred_cmd_int } > { 1 }
      {
        \msg_warning:nnnV
          { enumext } { many-starred }{#1} \l__enumext_check_start_line_env_tl
      }
    \int_gzero:N \g__enumext_check_starred_cmd_int
    \tl_clear:N \l__enumext_check_start_line_env_tl
  }
```

(*End of definition for* `\__enumext_check_starred_cmd:n`.)

13.31 Keys and functions associated with storage

13.31.1 Definition of variables

`\l__enumext_store_save_key_X_tl`
`\l__enumext_store_save_key_X_bool`

Internal variables used by `save-key` key (§13.31.4) and the *"storing structure"*.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \tl_new:c   { l__enumext_store_save_key_ #1 _tl   }
    \bool_new:c { l__enumext_store_save_key_ #1 _bool }
  }
\clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_store_save_key_X_tl` *and* `\l__enumext_store_save_key_X_bool`.)

13.31.2 Keys for `marks`, `wrap` and `show`

The enumext package provides a set of ⟨*keys*⟩ for manipulating *"symbol marks"* associated with *"answers"* and how they are displayed and stored in the *sequence* and *prop list* as well as an internal *"label and ref"* system.

`mark-ans*`
`mark-pos*`
`mark-sep*`
`wrap-ans*`
`wrap-opt`
`save-sep`
`show-ans`
`show-pos`

For the `keyans` and `keyans*` environments only the keys `mark-ans*`, `mark-pos*`, `mark-sep*`, `wrap-ans*`, `wrap-opt`, `save-sep`, `show-ans` and `show-pos` are added.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        mark-ans* .tl_set:c = { l__enumext_mark_answer_sym_ #2 _tl },
        mark-ans* .initial:n = \textasteriskcentered,
        mark-ans* .value_required:n = true,
        mark-pos* .choices:nn =
          { left , right , center }
          {
            \int_case:nn { \l_keys_choice_int }
              {
                {1} { \str_set:cn { l__enumext_mark_position_ #2 _str } { l } }
                {2} { \str_set:cn { l__enumext_mark_position_ #2 _str } { r } }
                {3} { \str_set:cn { l__enumext_mark_position_ #2 _str } { c } }
              }
          },
        mark-pos* .initial:n = right,
        mark-pos* .value_required:n = true,
        mark-pos* / unknown .code:n =
          \msg_error:nneee { enumext } { unknown-choice }
            { mark-pos* } { left,~right,~center } { \exp_not:n {##1} },
        mark-sep* .dim_set:c = { l__enumext_mark_sym_sep_ #2 _dim },
        mark-sep* .value_required:n = true,
        wrap-ans* .cs_set_protected:cp = { __enumext_keyans_wrapper_item_ #2 :n } ##1,
        wrap-ans* .value_required:n = true,
        wrap-opt  .cs_set_protected:cp = { __enumext_keyans_wrapper_opt_ #2 :n } ##1,
        wrap-opt  .initial:n = [{##1}],
        wrap-opt  .value_required:n = true,
        save-sep  .tl_set:c = { l__enumext_store_keyans_item_opt_sep_ #2 _tl },
        save-sep  .initial:n = {,~},
```

```
      save-sep  .value_required:n = true,
      show-ans  .bool_set:N = \l__enumext_show_answer_bool,
      show-ans  .initial:n = false,
      show-ans  .value_required:n = true,
      show-pos  .bool_set:N = \l__enumext_show_position_bool,
      show-pos  .initial:n = false,
      show-pos  .value_required:n = true,
    }
  }
\clist_map_inline:nn { {keyans}{v}, {keyans*}{viii} } { \__enumext_tmp:nn #1 }
```

(*End of definition for* `mark-ans*` *and others.*)

mark-ref
save-ref
show-ans
show-pos
mark-ans
mark-pos
mark-sep
wrap-ans
mark-ans*
mark-pos*
mark-sep*
wrap-ans*
wrap-opt
save-sep

Adds the ⟨*keys*⟩ `mark-ref` and `save-ref` related to the *"storage system"* and internal mechanism of *"label and ref"* along with the ⟨*keys*⟩ `show-ans`, `show-pos` and the ⟨*keys*⟩ `mark-ans`, `mark-pos`, `mark-sep` and `wrap-ans` for the command `\anskey`, the environment `anskey*` and the ⟨*keys*⟩ for environments `keyans` and `keyans*` only at the *first level* of `enumext` and `enumext*`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / #1 }
      {
        mark-ref .tl_set:N = \l__enumext_mark_ref_sym_tl,
        mark-ref .initial:n = \textreferencemark,
        mark-ref .value_required:n = true,
        save-ref .bool_set:N = \l__enumext_store_ref_key_bool,
        save-ref .initial:n = false,
        save-ref .value_required:n = true,
        show-ans .bool_set:N = \l__enumext_show_answer_bool,
        show-ans .initial:n = false,
        show-ans .value_required:n = true,
        show-pos .bool_set:N = \l__enumext_show_position_bool,
        show-pos .initial:n = false,
        show-pos .value_required:n = true,
        mark-ans .tl_set:N = \l__enumext_mark_answer_sym_tl,
        mark-ans .initial:n = \textasteriskcentered,
        mark-ans .value_required:n = true,
        mark-sep .dim_set:N = \l__enumext_mark_sym_sep_dim,
        mark-sep .value_required:n = true,
        mark-pos .choices:nn =
          { left , right , center }
          {
            \int_case:nn { \l_keys_choice_int }
              {
                {1} { \str_set:Nn \l__enumext_mark_position_str { l } }
                {2} { \str_set:Nn \l__enumext_mark_position_str { r } }
                {3} { \str_set:Nn \l__enumext_mark_position_str { c } }
              }
          },
        mark-pos .initial:n = right,
        mark-pos .value_required:n = true,
        mark-pos / unknown .code:n =
          \msg_error:nneee { enumext } { unknown-choice }
            { mark-pos } { left,~right,~center } { \exp_not:n {##1} },

        wrap-ans  .cs_set_protected:Np = \__enumext_anskey_wrapper:n ##1,
        wrap-ans  .initial:n =
                    {
                      \fbox{\parbox[t]{\dimeval{\itemwidth -2\fboxsep
                        -2\fboxrule}}{##1}}
                    },
        wrap-ans  .value_required:n = true,
        mark-ans* .code:n =
          {
            \keys_set:nn { enumext / keyans  } { mark-ans* = {##1} }
            \keys_set:nn { enumext / keyans* } { mark-ans* = {##1} }
          },
        mark-ans* .value_required:n = true,
        mark-pos* .code:n =
          {
            \keys_set:nn { enumext / keyans  } { mark-pos* = {##1} }
            \keys_set:nn { enumext / keyans* } { mark-pos* = {##1} }
```

```
      },
    mark-pos* .value_required:n = true,
    mark-sep* .code:n =
      {
        \keys_set:nn { enumext / keyans  } { mark-sep* = {##1} }
        \keys_set:nn { enumext / keyans* } { mark-sep* = {##1} }
      },
    mark-sep* .value_required:n = true,
    wrap-ans* .code:n =
      {
        \keys_set:nn { enumext / keyans  } { wrap-ans* = {##1} }
        \keys_set:nn { enumext / keyans* } { wrap-ans* = {##1} }
      },
    wrap-ans* .value_required:n = true,
    wrap-opt  .code:n =
      {
        \keys_set:nn { enumext / keyans  } { wrap-opt = {##1} }
        \keys_set:nn { enumext / keyans* } { wrap-opt = {##1} }
      },
    wrap-opt  .value_required:n = true,
    save-sep  .code:n =
      {
        \keys_set:nn { enumext / keyans  } { save-sep = {##1} }
        \keys_set:nn { enumext / keyans* } { save-sep = {##1} }
      },
    save-sep  .value_required:n = true,
  }
}
\clist_map_inline:nn { level-1, enumext* } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `mark-ref` *and others.*)

13.31.3 Storing structure of the environments

The idea behind *"storing structure"* in the *sequence* is to have a copy of the *structure of the environment* in which the key `save-ans` is being executed, so the *optional argument* passed to the levels of the environment in which it is executed must be captured and *"stored"* in the *sequence*.

`\__enumext_store_active_keys:n`
`\__enumext_store_active_keys_vii:n`

The functions `\__enumext_store_active_keys:n` and `\__enumext_store_active_keys_vii:n` will be responsible for the *"storing keys"* filtered from the *optional argument* of the environment in which the key `save-ans` is executed and the levels within this for the `enumext` and `enumext*` environments. This function is executed only if the variable `\l__enumext_store_save_key_X_bool` is false, that is, the key `save-key` is not active, establishing the variable `\l__enumext_store_save_key_X_tl` with the filtered ⟨*keys*⟩.

```
\cs_new_protected:Nn \__enumext_store_active_keys:n
  {
    \bool_if:cF { l__enumext_store_save_key_ \__enumext_level: _bool }
      {
        \tl_clear:c { l__enumext_store_save_key_ \__enumext_level: _tl }
        \tl_set:ce
          { l__enumext_store_save_key_ \__enumext_level: _tl }
          { \__enumext_filter_save_key:n {#1} }
      }
  }
\cs_new_protected:Nn \__enumext_store_active_keys_vii:n
  {
    \bool_if:NF \l__enumext_store_save_key_vii_bool
      {
        \tl_clear:N \l__enumext_store_save_key_vii_tl
        \tl_set:Ne \l__enumext_store_save_key_vii_tl
          { \__enumext_filter_save_key:n {#1} }
      }
  }
```

(*End of definition for* `\__enumext_store_active_keys:n` *and* `\__enumext_store_active_keys_vii:n`.)

13.31.4 Setting `save-key` key

Since this *"storing structure"* in the *sequence* established by the `save-ans` key when executing `\anskey` or `anskey*`, it cannot be modified. The best option here is to have a key that allows modifying the *optional argument* of the *"storing structure"* in the *sequence*.

save-key

The values set by this key passed in the *optional argument* of the enumext and enumext* environments will override the values of the \l__enumext_store_save_key_X_tl variable set by the functions __enumext_store_active_keys:n and __enumext_store_active_keys_vii:n. Now define the key save-key for all levels of enumext and enumext* environments.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / enumext* }
      {
        save-key .code:n = { \__enumext_parse_save_key_vii:n {##1} },
        save-key .value_required:n = true,
      }
    \keys_define:nn { enumext / #1 }
      {
        save-key .code:n = { \__enumext_parse_save_key:n {##1} },
        save-key .value_required:n = true,
      }
  }
\clist_map_inline:nn { level-1, level-2, level-3, level-4 } { \__enumext_tmp:n {#1} }
```

(*End of definition for* save-key.)

__enumext_parse_save_key:n
__enumext_parse_save_key_vii:n

The functions __enumext_parse_save_key:n and __enumext_parse_save_key_vii:n will be responsible for *"storing keys"* in the variable \l__enumext_store_save_key_X_tl for enumext and enumext*.

```
\cs_new_protected:Nn \__enumext_parse_save_key:n
  {
    \bool_set_true:c { l__enumext_store_save_key_ \__enumext_level: _bool }
    \tl_set:ce
      { l__enumext_store_save_key_ \__enumext_level: _tl }
      { \__enumext_filter_save_key:n {#1} }
  }
\cs_new_protected:Nn \__enumext_parse_save_key_vii:n
  {
    \bool_set_true:N \l__enumext_store_save_key_vii_bool
    \tl_clear:N \l__enumext_store_save_key_vii_tl
    \tl_set:Ne \l__enumext_store_save_key_vii_tl { \__enumext_filter_save_key:n {#1} }
  }
```

(*End of definition for* __enumext_parse_save_key:n *and* __enumext_parse_save_key_vii:n.)

13.31.5 Internal functions to store optional arguments

__enumext_filter_save_key:n
__enumext_filter_save_key_key:n
__enumext_filter_save_key_pair:nn

The function __enumext_filter_save_key:n will be in charge of *"filtering keys"* to be *stored* in *sequence* where {#1} represents the *optional argument* passed to the environment.

```
\cs_new:Nn \__enumext_filter_save_key:n
  {
    \use:e
      {
        \keyval_parse:NNn
          \__enumext_filter_save_key_key:n
          \__enumext_filter_save_key_pair:nn {#1}
      }
  }
```

The function __enumext_filter_save_key_key:n will be responsible for *"filtering keys"* that are passed *"without value"* by excluding the resume, resume*, reset, reset*, no-store and base-fix keys.

```
\cs_new:Nn \__enumext_filter_save_key_key:n
  {
    \str_case:nnF {#1}
      {
        { resume } { } { resume* } { } { reset } { } { reset* } { }
          { no-store } { } { base-fix } { }
      }
      { , { \exp_not:n {#1} } }
  }
```

The function __enumext_filter_save_key_pair:nn will be responsible for *"filtering keys"* that are passed *"with value"* by excluding the series, resume, save-ans, save-ref, save-key, check-ans, show-ans, show-pos, mark-ans, mark-pos, mark-sep, wrap-ans, mark-ans*, mark-pos*, mark-sep*, wrap-ans*, wrap-opt, save-sep, mark-ref, mini-env, mini-sep, mini-right and mini-right* keys.

```
\cs_new:Nn \__enumext_filter_save_key_pair:nn
```

```
{
  \str_case:nnF {#1}
    {
      { series     } { } { resume      } { } { save-ans  } { }
      { save-ref   } { } { save-key    } { } { check-ans } { }
      { show-ans   } { } { show-pos    } { } { mark-ans  } { }
      { mark-pos   } { } { mark-sep    } { } { wrap-ans  } { }
      { mark-ans*  } { } { mark-pos*   } { } { mark-sep* } { }
      { wrap-ans*  } { } { wrap-opt    } { } { save-sep  } { }
      { mark-ref   } { } { mini-env    } { } { mini-sep  } { }
      { mini-right } { } { mini-right* } { } { }
    }
    { , { \exp_not:n {#1} } = { \exp_not:n {#2} } }
}
```

(*End of definition for* `\__enumext_filter_save_key:n`, `\__enumext_filter_save_key_key:n`, *and* `\__enumext_filter_save_key_pair:nn`.)

13.31.6 Function for storing content in prop list

`\__enumext_store_addto_prop:n`
`\__enumext_store_addto_prop:V`

The function `\__enumext_store_addto_prop:n` stores the {⟨*content*⟩} in *prop list* defined by `save-ans` key. The *"stored content"* is retrieved by means of the `\getkeyans` command.

The form in which the {⟨*content*⟩} is *"stored"* in the *prop list* is {⟨*position*⟩}{⟨*content*⟩}. This function is used by `\anskey` in `enumext` and `enumext*` environments, `\item*` in `keyans` and `keyans*` environments and `\anspic*` in `keyanspic` environment. If there is no *store name*, because it was used outside the `save-ans` key and the error has already been reported, it does nothing.

```
\cs_new_protected:Nn \__enumext_store_addto_prop:n
  {
    \tl_if_empty:NF \l__enumext_store_name_tl
      {
        \prop_gput_if_not_in:cen { g__enumext_ \l__enumext_store_name_tl _prop }
          {
            \int_eval:n
              { \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop } + 1 }
          }
          {#1}
      }
  }
\cs_generate_variant:Nn \__enumext_store_addto_prop:n { V }
```

(*End of definition for* `\__enumext_store_addto_prop:n`.)

13.31.7 Function for storing content in sequence

`\__enumext_store_addto_seq:n`
`\__enumext_store_addto_seq:v`
`\__enumext_store_addto_seq:V`

The function `\__enumext_store_addto_seq:n` stores the {⟨*content*⟩} in *sequence* defined by `save-ans` key. This function is used by `\anskey` and `anskey*` in `enumext` and `enumext*`, `\item*` in `keyans` and `keyans*` and `\anspic*` in `keyanspic`.

The form in which the {⟨*content*⟩} is stored in *sequence* is in an internal `enumext` or `enumext*` environments with the *"same structure"* in which the command was executed.

The *"stored content"* is retrieved by means of the `\printkeyans` command. As in the previous function, it does nothing when there is no *store name*.

```
\cs_new_protected:Nn \__enumext_store_addto_seq:n
  {
    \tl_if_empty:NF \l__enumext_store_name_tl
      {
        \seq_gput_right:cn { g__enumext_ \l__enumext_store_name_tl _seq } {#1}
      }
  }
\cs_generate_variant:Nn \__enumext_store_addto_seq:n { v, V }
```

(*End of definition for* `\__enumext_store_addto_seq:n`.)

13.31.8 Functions for storing structure in the sequence

`\__enumext_store_level_open:`
`\__enumext_store_level_close:`

Within the `enumext` environment, the *"storing structure"* is handled per level by the functions `\__enumext_store_level_open:` and `\__enumext_store_level_close:`.

```
\cs_new_protected:Nn \__enumext_store_level_open:
  {
    \bool_if:NT \l__enumext_check_answers_bool
```

```
      {
        \tl_if_empty:cTF { l__enumext_store_save_key_ \__enumext_level: _tl }
          {
            \__enumext_store_addto_seq:n
              {
                \item \begin{enumext}
              }
          }
          {
            \tl_put_left:cn { l__enumext_store_save_key_ \__enumext_level: _tl }
              {
                \item \begin{enumext} [
              }
            \tl_put_right:cn { l__enumext_store_save_key_ \__enumext_level: _tl }
              {
                ]
              }
            \__enumext_store_addto_seq:v
              { l__enumext_store_save_key_ \__enumext_level: _tl }
          }
      }
  }
\cs_new_protected:Nn \__enumext_store_level_close:
  {
    \bool_if:NT \l__enumext_check_answers_bool
      {
        \__enumext_store_addto_seq:n { \end{enumext} }
      }
  }
```

(*End of definition for* `\__enumext_store_level_open:` *and* `\__enumext_store_level_close:`.)

`\__enumext_store_level_open_vii:`
`\__enumext_store_level_close_vii:`

The functions `\__enumext_store_level_open_vii:` and `\__enumext_store_level_close_vii:` handle the *"storing structure"* and are executed in the `enumext*` environment.

```
\cs_new_protected:Nn \__enumext_store_level_open_vii:
  {
    \bool_if:NT \l__enumext_check_answers_bool
      {
        \tl_if_empty:NTF \l__enumext_store_save_key_vii_tl
          {
            \__enumext_store_addto_seq:n
              {
                \item \begin{enumext*}
              }
          }
          {
            \tl_put_left:Nn \l__enumext_store_save_key_vii_tl
              {
                \item \begin{enumext*}[
              }
            \tl_put_right:Nn \l__enumext_store_save_key_vii_tl
              {
                ]
              }
            \__enumext_store_addto_seq:V \l__enumext_store_save_key_vii_tl
          }
      }
  }
\cs_new_protected:Nn \__enumext_store_level_close_vii:
  {
    \bool_if:NT \l__enumext_check_answers_bool
      {
        \__enumext_store_addto_seq:n { \end{enumext*} }
      }
  }
```

(*End of definition for* `\__enumext_store_level_open_vii:` *and* `\__enumext_store_level_close_vii:`.)

13.31.9 Function for show marks and position

`\__enumext_print_keyans_box:NN`
`\__enumext_print_keyans_box:cc`

The function `\__enumext_print_keyans_box:NN` prints a box in the left margin with the content of `\l__enumext_mark_answer_sym_tl`, used by the `wrap-ans`, `show-ans` and `show-pos` keys. The function takes two arguments:

```
#1 : \l__enumext_labelwidth_X_dim
#2 : \l__enumext_labelsep_X_dim

\cs_new_protected:Nn \__enumext_print_keyans_box:NN
  {
    \mode_leave_vertical:
    \skip_horizontal:n { -\dim_use:N #2 }
    \hbox_overlap_left:n
      {
        \makebox[ \dim_use:N #1 ][ \l__enumext_mark_position_str ]
          {
            \tl_use:N \l__enumext_mark_answer_sym_tl
          }
      }
    \skip_horizontal:n { \dim_use:N #2 }
  }
\cs_generate_variant:Nn \__enumext_print_keyans_box:NN { cc }
```

(*End of definition for* `\__enumext_print_keyans_box:NN`.)

13.32 The internal label and ref

The function `\__enumext_store_internal_ref:` handles the *"internal label and ref"* system used by the `save-ref` and `mark-ref` keys for `\anskey` allow executing `\ref{`⟨*store name* : *position*⟩`}` and will return `1.(a).i.A`.

`\__enumext_store_internal_ref:` First the dots "." are removed from the current ⟨*labels*⟩, since double dots in references are not wanted, then the result is placed in the variable `\l__enumext_newlabel_arg_two_tl`.

```
\cs_new_protected:Nn \__enumext_store_internal_ref:
  {
    \cs_set_protected:Nn \__enumext_tmp:n
      {
        \tl_set_eq:cc { l__enumext_label_copy_ ##1 _tl } { l__enumext_label_ ##1 _tl }
        \tl_reverse:c { l__enumext_label_copy_ ##1 _tl }
        \tl_remove_once:cn { l__enumext_label_copy_ ##1 _tl } { . }
        \tl_reverse:c { l__enumext_label_copy_ ##1 _tl }
      }
    \clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {##1} }
    \cs_set:Nn \__enumext_tmp:n
      { . \tl_use:c { l__enumext_label_copy_ \int_to_roman:n {##1} _tl } }
```

Here it is necessary to analyze the cases where the environment is started with `enumext*` and if `\anskey` or `anskey*` is running alone in it or if it is running in a nested `enumext` environment within the starting environment.

```
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \g__enumext_starred_bool }
        { \int_compare_p:nNn { \l__enumext_level_int } = { 0 } }
      }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          { \tl_use:N \l__enumext_label_copy_vii_tl }
      }
    \bool_lazy_all:nT
      {
        { \bool_not_p:n { \g__enumext_standard_bool } }
        { \bool_if_p:N \l__enumext_standard_bool }
        { \int_compare_p:nNn { \l__enumext_level_int } > { 0 } }
      }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          {
            \tl_use:N \l__enumext_label_copy_vii_tl
            \int_step_function:nnN { 1 } { \l__enumext_level_int } \__enumext_tmp:n
          }
      }
```

If started with `enumext` and if `\anskey` or `anskey*` is running alone in it or if it is running in a nested `enumext*` environment within the starting environment.

```
    \bool_lazy_all:nT
```

```
      {
        { \bool_if_p:N \g__enumext_standard_bool }
        { \int_compare_p:nNn { \l__enumext_level_int } > { 0 } }
        { \int_compare_p:nNn { \l__enumext_level_h_int } = { 0 } }
      }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          {
            \tl_use:N \l__enumext_label_copy_i_tl
            \int_step_function:nnN { 2 } { \l__enumext_level_int } \__enumext_tmp:n
          }
      }
    \cs_set:Nn \__enumext_tmp:n
      { \tl_use:c { l__enumext_label_copy_ \int_to_roman:n {##1} _tl } . }
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \g__enumext_standard_bool }
        { \bool_if_p:N \l__enumext_starred_bool }
        { \int_compare_p:nNn { \l__enumext_level_int } > { 0 } }
      }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          {
            \int_step_function:nnN { 1 } { \l__enumext_level_int } \__enumext_tmp:n
            \tl_use:N \l__enumext_label_copy_vii_tl
          }
      }
```

Now the variable `\l__enumext_newlabel_arg_one_tl` is set, which contains {⟨*store name* : *position*⟩}.

```
    \tl_put_right:Ne \l__enumext_newlabel_arg_one_tl
      {
        \l__enumext_store_name_tl \c_colon_str
        \int_eval:n { \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop } }
      }
```

Now the function `\__enumext_newlabel:nn` is executed and the result is saved in the variable `\l__enumext_write_aux_file_tl`, which is finally written in the `.aux` file.

```
    \tl_put_right:Ne \l__enumext_write_aux_file_tl
      {
        \__enumext_newlabel:nn
          { \exp_not:V \l__enumext_newlabel_arg_one_tl }
          { \l__enumext_newlabel_arg_two_tl }
      }
    \l__enumext_write_aux_file_tl
  }
```

(*End of definition for* `\__enumext_store_internal_ref:`.)

13.33 Common functions for \anskey and anskey* environment

13.33.1 Definition of variables

`\l__enumext_store_anskey_arg_tl`

The variable `\l__enumext_store_anskey_arg_tl` saves the *argument* of `\anskey` (§13.34).

```
\tl_new:N \l__enumext_store_anskey_arg_tl
```

(*End of definition for* `\l__enumext_store_anskey_arg_tl`.)

13.33.2 Definition of error messages

`anskey-unnumber-item`
`anskey-empty-arg`
`anskey-math-mode`

Messages used by `\anskey` and `anskey*`.

```
\msg_new:nnnn { enumext } { anskey-unnumber-item }
  {
    Can't~store~with~an~unnumbered~'\token_to_str:N \item'~\msg_line_context:.
  }
  {
    Store~the~content~with~a~numbered~'\token_to_str:N \item'.
  }
\msg_new:nnnn { enumext } { anskey-empty-arg }
  {
    Can't~store~empty~content~\msg_line_context:.
```

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```
3047    }
3048    {
3049      Give~some~content~to~'\token_to_str:N \anskey'~or~remove~the~command.
3050    }
3051  \msg_new:nnnn { enumext } { anskey-math-mode }
3052    {
3053      '#1'~can't~work~in~math~mode~\msg_line_context:.
3054    }
3055    {
3056      Leave~math~mode~before~using~'#1'.
3057    }
```

(*End of definition for* `anskey-unnumber-item`, `anskey-empty-arg`, *and* `anskey-math-mode`.)

13.33.3 Internal functions common to \anskey and anskey*

`\__enumext_store_anskey_arg:n`
`\__enumext_store_anskey_arg:e`

The internal function `\__enumext_store_anskey_arg:n` first passes the {⟨*argument*⟩} to the *prop list*, then checks the state of the variable `\l__enumext_store_ref_key_bool` handled by the `save-ref` key and calls the function `\__enumext_store_internal_ref:` for the *"internal label and ref"* system. After this, if the `show-ans` or `show-pos` keys are active, it shows the *"wrapped"* {⟨*argument*⟩}.

```
3058  \cs_new_protected:Nn \__enumext_store_anskey_arg:n
3059    {
3060      \int_gincr:N \g__enumext_item_anskey_int
3061      \__enumext_store_addto_prop:n {#1}
3062      \bool_if:NT \l__enumext_store_ref_key_bool
3063        {
3064          \__enumext_store_internal_ref:
3065        }
3066      \__enumext_anskey_show_wrap_left:n {#1}
```

Now the processing of the [⟨*key = val*⟩] passed to the command starts, building the `\item` in the variable `\l__enumext_store_anskey_arg_tl` which is *"stored"* in the *sequence*. First the variable `\l__enumext_store_anskey_arg_tl` is cleared and the ⟨*keys*⟩ are processed; if the `break-col` key is present and the command is running under `enumext` (not in `enumext*`), `\columnbreak` and then `\item` are added.

```
3067      \tl_clear:N \l__enumext_store_anskey_arg_tl
3068      \bool_lazy_and:nnT
3069        { \bool_if_p:N \l__enumext_store_columns_break_bool }
3070        { \bool_not_p:n { \l__enumext_starred_bool } }
3071        {
3072          \tl_put_left:Nn \l__enumext_store_anskey_arg_tl { \columnbreak }
3073        }
3074      \tl_put_right:Nn \l__enumext_store_anskey_arg_tl { \item }
```

If the `item-join` key is present and the command is not running under `enumext*`, (⟨*number*⟩) is added to `\l__enumext_store_anskey_arg_tl`.

```
3075      \bool_lazy_and:nnT
3076        { \bool_not_p:n { \l__enumext_starred_bool } }
3077        { \int_compare_p:nNn { \l__enumext_store_item_join_int } > { 1 } }
3078        {
3079          \tl_put_right:Ne \l__enumext_store_anskey_arg_tl
3080            {
3081              ( \exp_not:V \l__enumext_store_item_join_int )
3082            }
3083        }
```

Then the keys `item-star`, `item-sym*` and `item-pos*` are reviewed and passed, along with the {⟨*argument*⟩} for `\anskey` or ⟨*body*⟩ for `anskey*`, to `\l__enumext_store_anskey_arg_tl`.

```
3084      \bool_if:NTF \l__enumext_store_item_star_bool
3085        {
3086          \tl_put_right:Nn \l__enumext_store_anskey_arg_tl { * }
3087          \tl_if_empty:NF \l__enumext_store_item_symbol_tl
3088            {
3089              \tl_put_right:Ne \l__enumext_store_anskey_arg_tl
3090                {
3091                  [ \exp_not:V \l__enumext_store_item_symbol_tl ]
3092                }
3093            }
3094          \dim_compare:nT
```

```
3095            {
3096              \l__enumext_store_item_symbol_sep_dim != \c_zero_dim
3097            }
3098            {
3099              \tl_put_right:Ne \l__enumext_store_anskey_arg_tl
3100                {
3101                  [ \exp_not:V \l__enumext_store_item_symbol_sep_dim ]
3102                }
3103            }
3104          \tl_put_right:Nn \l__enumext_store_anskey_arg_tl {#1}
3105        }
3106        {
3107          \tl_put_right:Nn \l__enumext_store_anskey_arg_tl {#1}
3108        }
```

Finally it checks if the `save-ref` key is active along with the `hyperref` package load, if both conditions are met, it will create the `\hyperlink` with *"symbol"* set by `mark-ref` key and then store in *sequence*.

```
3109      \bool_lazy_and:nnT
3110        { \bool_if_p:N \l__enumext_store_ref_key_bool }
3111        { \bool_if_p:N \l__enumext_hyperref_bool }
3112        {
3113          \tl_put_right:Ne \l__enumext_store_anskey_arg_tl
3114            {
3115              \hfill \exp_not:N \hyperlink
3116                { \exp_not:V \l__enumext_newlabel_arg_one_tl }
3117                { \exp_not:V \l__enumext_mark_ref_sym_tl }
3118            }
3119        }
3120      \__enumext_store_addto_seq:V \l__enumext_store_anskey_arg_tl
3121    }
3122  \cs_generate_variant:Nn \__enumext_store_anskey_arg:n { e }
```

(*End of definition for* `\__enumext_store_anskey_arg:n`.)

`\__enumext_anskey_show_wrap_arg:n` The function `\__enumext_anskey_show_wrap_arg:n` *"wraps"* the {⟨*argument*⟩} passed to `\anskey` and the ⟨*body*⟩ for `anskey*` when using the `wrap-ans` and `mark-sep` keys.

```
3123  \cs_new_protected:Nn \__enumext_anskey_show_wrap_arg:n
3124    {
3125      \par
3126      \bool_if:NTF \l__enumext_starred_bool
3127        {
3128          \dim_compare:nNnT { \l__enumext_mark_sym_sep_dim } = { \c_zero_dim }
3129            {
3130              \dim_set:Nn \l__enumext_mark_sym_sep_dim { \l__enumext_labelsep_vii_dim }
3131            }
3132          \__enumext_print_keyans_box:NN
3133            \l__enumext_labelwidth_vii_dim \l__enumext_mark_sym_sep_dim
3134        }
3135        {
3136          \dim_compare:nNnT { \l__enumext_mark_sym_sep_dim } = { \c_zero_dim }
3137            {
3138              \dim_set:Nn \l__enumext_mark_sym_sep_dim
3139                {
3140                  \dim_use:c {l__enumext_labelsep_ \__enumext_level: _dim }
3141                }
3142            }
3143          \__enumext_print_keyans_box:cc
3144            { l__enumext_labelwidth_ \__enumext_level: _dim }
3145            { l__enumext_mark_sym_sep_dim }
3146        }
3147      \__enumext_anskey_wrapper:n {#1}
3148    }
```

(*End of definition for* `\__enumext_anskey_show_wrap_arg:n`.)

`\__enumext_anskey_show_wrap_left:n` The function `\__enumext_anskey_show_wrap_left:n` will show the *"mark"* defined by the `mark-ans` key or the *"position"* of the {⟨*content*⟩} stored in the *prop list* when using the `show-pos` key on the left margin next to the *"wraps"* {⟨*argument*⟩} passed to `\anskey` and the ⟨*body*⟩ in `anskey*` on the right side when using the `show-ans` key.

```
3149  \cs_new_protected:Nn \__enumext_anskey_show_wrap_left:n
```

```
  {
    \bool_if:NT \l__enumext_show_answer_bool
      {
        \__enumext_anskey_show_wrap_arg:n {#1}
      }
    \bool_if:NT \l__enumext_show_position_bool
      {
        \tl_set:Ne \l__enumext_mark_answer_sym_tl
          {
            \group_begin:
            \exp_not:N \normalfont
            \exp_not:N \footnotesize [ \int_eval:n
              {
                \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop }
              }
              ]
            \group_end:
          }
        \__enumext_anskey_show_wrap_arg:n {#1}
      }
  }
```

(*End of definition for* `\__enumext_anskey_show_wrap_left:n`.)

13.34 The command \anskey

Since *"content"* is stored in a `list` environment within *sequences* and the options passed to each level can be managed (more or less), it is necessary to have a little more control over `\item` when storing.

The `\anskey` command will cover this point and give it similar behavior to that of `\item` in the `enumext` and `enumext*` environments executed as follows `\anskey[`⟨*key* = *val*⟩`]{`⟨*content*⟩`}`.

13.34.1 Definition of variables for \anskey

`\l__enumext_anskey_level_int`

The integer variable `\l__enumext_anskey_level_int` will control the nesting level of the `\anskey` command.

```
\int_new:N \l__enumext_anskey_level_int
```

(*End of definition for* `\l__enumext_anskey_level_int`.)

13.34.2 Definition of error messages for \anskey

`anskey-wrong-place`
`anskey-nested`
`anskey-cmd-key-unknown`
`anskey-cmd-key-value-unknown`

Messages used by `\anskey` command.

```
\msg_new:nnnn { enumext } { anskey-wrong-place }
  {
    Wrong~place~for~command~'\c_backslash_str #1'~\msg_line_context:.
  }
  {
    '\c_backslash_str #1'~works~in~the~environment~'#2'.
  }
\msg_new:nnnn { enumext } { anskey-nested }
  {
    The~command~'\token_to_str:N \anskey'~can't~be~nested~
    \msg_line_context:.
  }
  {
    Close~the~first~'\token_to_str:N \anskey'~before~using~another~one.
  }
\msg_new:nnnn { enumext } { anskey-cmd-key-unknown }
  {
    The~key~'#1'~is~unknown~by~'\token_to_str:N \anskey'~and~is~being~
    ignored~\msg_line_context:.
  }
  {
    The~command~'\token_to_str:N \anskey'~does~not~have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { anskey-cmd-key-value-unknown }
  {
    The~key~'#1=#2'~is~unknown~by~'\token_to_str:N \anskey'~and~is~being~
    ignored~\msg_line_context:.
  }
```

```
3201   {
3202     The~command~'\token_to_str:N \anskey'~does~not~have~a~key~called~'#1'.~
3203     Check~that~you~have~spelled~the~key~name~correctly.
3204   }
```

(*End of definition for* `anskey-wrong-place` *and others.*)

13.34.3 Definition of keys for \anskey

break-col
item-join
item-star
item-sym*
item-pos*
unknown

First, the keys `break-col`, `item-join`, `item-star`, `item-sym*` and `item-pos*` are added.

```
3205 \keys_define:nn { enumext / anskey }
3206   {
3207     break-col .bool_set:N = \l__enumext_store_columns_break_bool,
3208     break-col .default:n = true,
3209     break-col .value_forbidden:n = true,
3210     item-join .int_set:N = \l__enumext_store_item_join_int,
3211     item-join .value_required:n = true,
3212     item-star .bool_set:N = \l__enumext_store_item_star_bool,
3213     item-star .default:n = true,
3214     item-star .value_forbidden:n = true,
3215     item-sym* .tl_set:N = \l__enumext_store_item_symbol_tl,
3216     item-sym* .value_required:n = true,
3217     item-pos* .dim_set:N = \l__enumext_store_item_symbol_sep_dim,
3218     item-pos* .value_required:n = true,
3219     unknown   .code:n = { \__enumext_anskey_unknown:n {#1} },
3220   }
```

(*End of definition for* `break-col` *and others.*)

13.34.4 Internal functions for the command

__enumext_anskey_unknown:n
__enumext_anskey_unknown:nn
__enumext_anskey_unknown:Vn

The ⟨*keys*⟩ are stored in `\l_keys_key_str` and the value (if any) is passed as an argument to the function `\__enumext_anskey_unknown:n`.

```
3221 \cs_new_protected:Nn \__enumext_anskey_unknown:n
3222   {
3223     \__enumext_anskey_unknown:Vn \l_keys_key_str {#1}
3224   }
3225 \cs_new_protected:Nn \__enumext_anskey_unknown:nn
3226   {
3227     \tl_if_blank:nTF {#2}
3228       {
3229         \msg_error:nnn { enumext } { anskey-cmd-key-unknown } {#1}
3230       }
3231       {
3232         \msg_error:nnnn { enumext } { anskey-cmd-key-value-unknown } {#1} {#2}
3233       }
3234   }
3235 \cs_generate_variant:Nn \__enumext_anskey_unknown:nn { V }
```

(*End of definition for* `\__enumext_anskey_unknown:n` *and* `\__enumext_anskey_unknown:nn`.)

__enumext_in_keyans:

Inside `keyans`, `keyans*` and `keyanspic` the flag `\l__enumext_store_active_bool` is set to false on purpose, so the `save-ans` checks cannot use it there. The predicate `\__enumext_in_keyans:` is true when any of these environments is open, and it avoids a second error message for the same mistake.

```
3236 \prg_new_conditional:Npnn \__enumext_in_keyans: { p , T , F , TF }
3237   {
3238     \int_compare:nNnTF
3239       { \l__enumext_keyans_level_int + \l__enumext_keyans_level_h_int
3240         + \l__enumext_keyans_pic_level_int } > { 0 }
3241       { \prg_return_true: } { \prg_return_false: }
3242   }
```

(*End of definition for* `\__enumext_in_keyans:`.)

__enumext_anskey_safe_outer:
__enumext_anskey_safe_inner:

The `\__enumext_anskey_safe_outer:` function will return the appropriate messages when the command is executed outside the environment in which the `save-ans` key was activated or inside the `keyans`, `keyans*` or `keyanspic` environments.

```
3243 \cs_new_protected:Nn \__enumext_anskey_safe_outer:
3244   {
3245     \bool_lazy_or:nnF { \l__enumext_store_active_bool } { \__enumext_in_keyans_p: }
```

```
      {
        \msg_error:nnnn { enumext } { anskey-wrong-place }{ anskey }{ enumext }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_int } = { 1 }
      {
        \msg_error:nnnn { enumext } { command-wrong-place }{ anskey }{ keyans }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \msg_error:nnnn { enumext } { command-wrong-place }{ anskey }{ keyans* }
      }
    \int_compare:nNnT { \l__enumext_keyans_pic_level_int } = { 1 }
      {
        \msg_error:nnnn { enumext }
          { command-wrong-place }{ anskey }{ keyanspic }
      }
  }
```

The `\__enumext_anskey_safe_inner:` function will first check if the command is nested, if preceded by a not numbered `\item` or if it is in *math mode* returning the appropriate messages.

```
\cs_new_protected:Nn \__enumext_anskey_safe_inner:
  {
    \int_incr:N \l__enumext_anskey_level_int
    \int_compare:nNnT { \l__enumext_anskey_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { anskey-nested }
      }
    \bool_if:NF \l__enumext_item_number_bool
      {
        \msg_error:nn { enumext } { anskey-unnumber-item }
      }
    \mode_if_math:T
      {
        \msg_error:nne { enumext } { anskey-math-mode }
          { \token_to_str:N \anskey }
      }
  }
```

(*End of definition for* `\__enumext_anskey_safe_outer:` *and* `\__enumext_anskey_safe_inner:`.)

The `\anskey` command will only be present when using the `save-ans` key in `enumext` and `enumext*` environments, otherwise it will return an error.

`\anskey` The command accepts an optional `[`⟨*key* = *val*⟩`]` argument in '`#1`' and a mandatory `{`⟨*content*⟩`}` in '`#2`'. The function `\__enumext_anskey_safe_outer:` is called first to be sure where the command is executed, then the state of the variable `\l__enumext_check_answers_bool` set by the key `no-store` is checked; if it is true, `\g__enumext_item_anskey_int` is incremented for the internal *"check answer"* system and the function `\__enumext_anskey_safe_inner:n` is executed to ensure that the command is not nested and that the argument is not empty; finally the `[`⟨*key* = *val*⟩`]` is searched and the function `\__enumext_store_anskey_arg:n` is called.

```
\NewDocumentCommand \anskey { o +m }
  {
    \__enumext_anskey_safe_outer:
    \group_begin:
      \bool_if:NT \l__enumext_check_answers_bool
        {
          \tl_if_novalue:nF {#1}
            {
              \keys_set:nn { enumext / anskey } {#1}
            }
          \tl_if_blank:nTF {#2}
            {
              \msg_error:nn { enumext } { anskey-empty-arg }
            }
            {
              \__enumext_anskey_safe_inner:
              \__enumext_store_anskey_arg:n {#2}
            }
        }
    \group_end:
  }
```

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(*End of definition for* `\anskey`. *This function is documented on page* 16.)

13.35 The environment anskey*

The original implementation of the anskey* environment used non-public functions from the scontents[17] package, which was not the best approach. Fortunately LaTeX release 2025-06-01 implemented the new `c-type` argument in the ltcmd[11], with which the ⟨*body*⟩ of the environment can be recorded in *verbatim mode*, and `\tl_retokenize:n` (wrapper around the `\scantokens`) provided by LaTeX3 release 2025-07-08 does the work as the original implementation.

13.35.1 Definition of variables for anskey*

`\l__enumext_store_anskey_env_tl`
`\l__enumext_write_anskey_env_bool`
`\l__enumext_write_anskey_env_file_name_tl`
`\l__enumext_write_anskey_env_file_iow`

The variable `\l__enumext_store_anskey_env_tl` saves the ⟨*body*⟩ of the environment anskey* (§13.35). In the implementation of the anskey* environment, the keys `write-env` and `overwrite` use the variables `\l__enumext_write_anskey_env_bool`, `\l__enumext_write_anskey_env_file_name_tl` and `\l__enumext_write_anskey_env_file_iow`.

```
\tl_new:N   \l__enumext_store_anskey_env_tl
\bool_new:N \l__enumext_write_anskey_env_bool
\tl_new:N   \l__enumext_write_anskey_env_file_name_tl
\iow_new:N  \l__enumext_write_anskey_env_file_iow
```

(*End of definition for* `\l__enumext_store_anskey_env_tl` *and others.*)

`\c__enumext_anskey_env_hidden_space_str`

The `\c__enumext_anskey_env_hidden_space_str` is a constant *string* used to hide the ⟨*forced space*⟩ added by TeX when recording content in a macro. This *string* contains the *reserved phrase* '`%^^Aenumextheol%`' which is added to the end of the argument stored in *sequence* and *prop list* when the key `force-eol` is false.

```
\str_const:Ne \c__enumext_anskey_env_hidden_space_str
  { \c_percent_str \c_circumflex_str \c_circumflex_str A enumextheol
    \c_percent_str }
```

(*End of definition for* `\c__enumext_anskey_env_hidden_space_str`.)

13.35.2 Definition of error messages for anskey*

`anskey-env-error`

Message used by reserved anskey* environment by enumext package.

```
\msg_new:nnnn { enumext } { anskey-env-error }
  {
    The~environment~'#1'~is~reserved~by~'enumext'~package,~
    it~is~already~defined~\msg_line_context:.
  }
  {
    The~environment~'#1'~is~defined~internally~
    for~the~'save-ans'~key~with~save-ans~key~active.~See~documentation.
  }
```

(*End of definition for* `anskey-env-error`.)

`anskey-env-wrong`
`anskey-env-key-unknown`
`anskey-env-key-value-unknown`

Messages used by anskey* environment.

```
\msg_new:nnnn { enumext } { anskey-env-wrong }
  {
    The~environment~anskey*~cannot~be~used~in~'#1'~\msg_line_context:.
  }
  {
    'anskey*'~can~only~be~used~with~the~key~'save-ans'~in~
    'enumext'~or~'enumext*'.
  }
\msg_new:nnnn { enumext } { anskey-env-key-unknown }
  {
    The~key~'#1'~is~unknown~by~environment~
    'anskey*'~and~is~being~ignored~\msg_line_context:.
  }
  {
    The~environment~'anskey*'~does~not~have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { anskey-env-key-value-unknown }
  {
    The~key~'#1=#2'~is~unknown~by~environment~
    'anskey*'~and~is~being~ignored~\msg_line_context:.
```

```
  }
  {
    The~environment~'anskey*'~does~not~have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
```

(*End of definition for* `anskey-env-wrong` , `anskey-env-key-unknown` , *and* `anskey-env-key-value-unknown`.)

13.35.3 Definition of messages for writing files in anskey*

These messages are not error messages, they report to the terminal what happens with the file written by the environment.

overwrite-file
writing-file
not-writing

Messages used when anskey* writes the external file.

```
\msg_new:nnn { enumext } { overwrite-file }
  {
    Overwriting~file~'#1'.
  }
\msg_new:nnn { enumext } { writing-file }
  {
    Writing~file~'#1'.
  }
\msg_new:nnn { enumext } { not-writing }
  {
    File~'#1'~already~exists.~Not~writing.
  }
```

(*End of definition for* `overwrite-file` , `writing-file` , *and* `not-writing`.)

13.35.4 Definition of keys for anskey*

break-col
item-join
item-star
item-sym*
item-pos*
force-eol
write-env
overwrite
unknown

First, the same keys from the \anskey command are added along with the force-eol, write-env and overwrite keys that were in the original implementation that used the scontents support package for these.

```
\keys_define:nn { enumext / anskey* }
  {
    break-col .bool_set:N = \l__enumext_store_columns_break_bool,
    break-col .default:n = true,
    break-col .value_forbidden:n = true,
    item-join .int_set:N = \l__enumext_store_item_join_int,
    item-join .value_required:n = true,
    item-star .bool_set:N = \l__enumext_store_item_star_bool,
    item-star .default:n = true,
    item-star .value_forbidden:n = true,
    item-sym* .tl_set:N = \l__enumext_store_item_symbol_tl,
    item-sym* .value_required:n = true,
    item-pos* .dim_set:N = \l__enumext_store_item_symbol_sep_dim,
    item-pos* .value_required:n = true,
    force-eol .bool_set:N = \l__enumext_anskey_env_force_eol_bool,
    force-eol .initial:n = false,
    force-eol .default:n = true,
    write-env .code:n =
      {
        \bool_set_true:N \l__enumext_write_anskey_env_bool
        \tl_set:Nn \l__enumext_write_anskey_env_file_name_tl {#1}
      },
    write-env .value_required:n = true,
    overwrite .bool_set:N = \l__enumext_anskey_env_overwrite_bool,
    overwrite .initial:n = false,
    overwrite .default:n = true,
    unknown   .code:n = { \__enumext_anskey_env_unknown:n {#1} },
  }
```

(*End of definition for* `break-col` *and others.*)

13.35.5 Internal functions for the environment

__enumext_anskey_env_unknown:n
__enumext_anskey_env_unknown:nn
__enumext_anskey_env_unknown:Vn

The ⟨*keys*⟩ are stored in \l_keys_key_str and the value (if any) is passed as an argument to the function __enumext_anskey_env_unknown:n.

```
\cs_new_protected:Nn \__enumext_anskey_env_unknown:n
  {
    \__enumext_anskey_env_unknown:Vn \l_keys_key_str {#1}
```

```
  }
\cs_new_protected:Nn \__enumext_anskey_env_unknown:nn
  {
    \tl_if_blank:nTF {#2}
      {
        \msg_error:nnn { enumext } { anskey-env-key-unknown } {#1}
      }
      {
        \msg_error:nnnn { enumext } { anskey-env-key-value-unknown } {#1} {#2}
      }
  }
\cs_generate_variant:Nn \__enumext_anskey_env_unknown:nn { V }
```

(*End of definition for* `\__enumext_anskey_env_unknown:n` *and* `\__enumext_anskey_env_unknown:nn`.)

`\__enumext_anskey_env_file_if_writable:n`
`\__enumext_anskey_env_file_if_writable:nT`
`\__enumext_anskey_env_file_if_writable:nF`
`\__enumext_anskey_env_file_if_writable:nTF`
`\__enumext_anskey_env_file_write:nn`
`\__enumext_anskey_env_file_write:VV`

The conditional function `\__enumext_anskey_env_file_if_writable:n` is used by the `write-env` and `overwrite` keys in the `anskey*` environment to determine whether the output file is written or overwritten.

```
\prg_new_protected_conditional:Npnn \__enumext_anskey_env_file_if_writable:n #1
  { T, F, TF }
  {
    \bool_if:NTF \l__enumext_write_anskey_env_bool
      {
        \file_if_exist:nTF {#1}
          {
            \bool_if:NTF \l__enumext_anskey_env_overwrite_bool
              {
                \msg_warning:nne { enumext } { overwrite-file } {#1}
                \prg_return_true:
              }
              {
                \msg_warning:nne { enumext } { not-writing } {#1}
                \prg_return_false:
              }
          }
          {
            \msg_warning:nne { enumext } { writing-file } {#1}
            \prg_return_true:
          }
      }
      { \prg_return_false: }
  }
```

The `\__enumext_anskey_env_file_write:nn` function is used by the `write-env` key in the `anskey*` environment to write the output file with the ⟨*body*⟩ of the environment.

```
\cs_new_protected:Nn \__enumext_anskey_env_file_write:nn
  {
    \__enumext_anskey_env_file_if_writable:nT {#1}
      {
        \iow_open:Nn \l__enumext_write_anskey_env_file_iow {#1}
        \iow_now:Nn  \l__enumext_write_anskey_env_file_iow {#2}
        \iow_close:N \l__enumext_write_anskey_env_file_iow
      }
  }
\cs_generate_variant:Nn \__enumext_anskey_env_file_write:nn { VV }
```

(*End of definition for* `\__enumext_anskey_env_file_if_writable:n` *and others.*)

`\__enumext_anskey_env_safe_outer:`
`\__enumext_anskey_env_safe_inner:`
`\__enumext_store_anskey_env:n`

The function `\__enumext_anskey_env_safe_outer:` will return the appropriate messages when `anskey*` is executed outside the environment in which the `save-ans` key was activated or within the `keyans`, `keyans*` or `keyanspic` environments.

```
\cs_new_protected:Nn \__enumext_anskey_env_safe_outer:
  {
    \bool_lazy_or:nnF { \l__enumext_store_active_bool } { \__enumext_in_keyans_p: }
      {
        \msg_error:nnn { enumext } { anskey-env-error } { anskey* }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_int } = { 1 }
      {
        \msg_error:nnn { enumext } { anskey-env-wrong }{ keyans }
      }
```

```
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \msg_error:nnn { enumext } { anskey-env-wrong } { keyans* }
      }
    \int_compare:nNnT { \l__enumext_keyans_pic_level_int } = { 1 }
      {
        \msg_error:nnn { enumext } { anskey-env-wrong } { keyanspic }
      }
  }
```

The function `\__enumext_anskey_env_safe_inner:` will first check if preceded by a not numbered `\item` or if it is in *math mode* returning the appropriate messages.

```
\cs_new_protected:Nn \__enumext_anskey_env_safe_inner:
  {
    \bool_if:NF \l__enumext_item_number_bool
      {
        \msg_error:nn { enumext } { anskey-unnumber-item }
      }
    \mode_if_math:T
      {
        \msg_error:nnn { enumext } { anskey-math-mode } { anskey* }
      }
  }
```

The `\__enumext_store_anskey_env:n` function will first pass the `c-type` argument ⟨*body*⟩ to `\l__enumext_store_anskey_env_tl` and replace the macro `\obeyedline` with `^^J`. Then it executes the `write-env` and `overwrite` keys, checks the state of `\l__enumext_anskey_env_force_eol_bool` managed by the `force-eol` key, and adds `\c__enumext_anskey_env_hidden_space_str` if necessary. Finally it calls `\__enumext_store_anskey_arg:e` to expand the function `\tl_retokenize:n`, which rescans `\l__enumext_store_anskey_env_tl` before processing it.

```
\cs_new_protected:Nn \__enumext_store_anskey_env:n
  {
    \tl_set:Nn \l__enumext_store_anskey_env_tl {#1}
    \RenewDocumentCommand \obeyedline { } { \iow_char:N \^^J }
    \tl_replace_all:Nee \l__enumext_store_anskey_env_tl { \obeyedline }
      { \iow_char:N \^^J }
    \__enumext_anskey_env_file_write:VV
      \l__enumext_write_anskey_env_file_name_tl \l__enumext_store_anskey_env_tl
    \bool_if:NF \l__enumext_anskey_env_force_eol_bool
      {
        \tl_put_right:Ne \l__enumext_store_anskey_env_tl
          {
            \c__enumext_anskey_env_hidden_space_str
          }
      }
    \__enumext_store_anskey_arg:e
      {
        \tl_retokenize:n { \l__enumext_store_anskey_env_tl }
      }
  }
```

Since `\obeyedline` can be redefined by the user, for example to `\mbox{}\par`, it is necessary to redefine it to `^^J` in order to use `\tl_replace_all:Nee` otherwise it returns an error.

(*End of definition for* `\__enumext_anskey_env_safe_outer:`, `\__enumext_anskey_env_safe_inner:`, *and* `\__enumext_store_anskey_env:n`.)

`anskey*` The environment accepts an optional [⟨*key* = *val*⟩] argument in '`#1`' and a `c-type` argument in '`#2`'. First, the function `\__enumext_anskey_env_safe_outer:` is called to make sure where the environment is running, then the state of the variable `\l__enumext_check_answers_bool` set by the key `no-store` is checked. If it is true, it looks for [⟨*key* = *val*⟩] and verifies that the *argument* `c-type` ⟨*body*⟩ is not empty. Finally, it runs the internal check function `\__enumext_anskey_env_safe_inner:n` and calls the function `\__enumext_store_anskey_arg:n`.

```
\NewDocumentEnvironment{anskey*}{ o c }
  {
    \__enumext_anskey_env_safe_outer:
    \bool_if:NT \l__enumext_check_answers_bool
      {
        \tl_if_novalue:nF {#1}
          {
```

```
3489              \keys_set:nn { enumext / anskey* } {#1}
3490            }
3491          \tl_if_blank:nTF {#2}
3492            {
3493              \msg_error:nn { enumext } { anskey-empty-arg }
3494            }
3495            {
3496              \__enumext_anskey_env_safe_inner:
3497              \__enumext_store_anskey_env:n {#2}
3498            }
3499        }
3500    } { }
```

(*End of definition for* anskey*. This function is documented on page* 17.)

13.36 Executing check-ans system and write .log

__enumext_execute_after_env:

The __enumext_execute_after_env: function will first return the appropriate message for the end of the environment in which the save-ans key is being executed, then calls the __enumext_item_answer_diff: function and then writes the values of the global variables used to the .log file. If the key check-ans is active, it executes the function __enumext_check_ans_show:, which warns on the terminal if the numbers differ, otherwise it executes the function __enumext_check_ans_log: and writes the results in the .log file, and finally executes the function __enumext_reset_global_vars: returning the used variables to their original state.

```
3501 \cs_new_protected:Nn \__enumext_execute_after_env:
3502   {
3503     \int_compare:nNnT { \l__enumext_level_int } = { 0 }
3504       {
3505         \tl_if_empty:NF \g__enumext_store_name_tl
3506           {
3507             \__enumext_stop_save_ans_msg:
3508             \__enumext_item_answer_diff:
3509             \__enumext_log_global_vars:
3510             \__enumext_log_answer_vars:
3511             \bool_if:NTF \g__enumext_check_ans_key_bool
3512               {
3513                 \__enumext_check_ans_show:
3514               }
3515               { \__enumext_check_ans_log: }
3516           }
3517         \__enumext_reset_global_vars:
3518       }
3519   }
```

This function is passed to the function __enumext_after_env:nn for the environments enumext (§13.43) and enumext* (§13.48) and it is executed only when the environments are not nested or at some level of these.

(*End of definition for* __enumext_execute_after_env:.)

13.37 Common functions for keyans, keyans* and keyanspic

13.37.1 Definition of variables

\l__enumext_mark_sep_tmpa_dim
\l__enumext_mark_sep_tmpb_dim
\l__enumext_show_pos_tmp_int

Internal variables used by mark-sep, show-ans and show-pos keys (§13.31).

```
3520 \dim_new:N \l__enumext_mark_sep_tmpa_dim
3521 \dim_new:N \l__enumext_mark_sep_tmpb_dim
3522 \int_new:N \l__enumext_show_pos_tmp_int
```

(*End of definition for* \l__enumext_mark_sep_tmpa_dim, \l__enumext_mark_sep_tmpb_dim, *and* \l__enumext_show_pos_tmp_int.)

13.37.2 Definition of error messages

keyans-wrong-level
wrong-place

Messages used by keyans, keyans* and keyanspic environments.

```
3523 \msg_new:nnnn { enumext } { keyans-wrong-level }
3524   {
3525     Wrong~level~position~for~'keyans'~\msg_line_context:.
3526   }
3527   {
3528     The~environment~'keyans'~can~only~be~in~the~first~level.
3529   }
```

```
\msg_new:nnnn { enumext } { wrong-place }
  {
    Wrong~place~for~'#1'~environment~\msg_line_context:.
  }
  {
    '#1'~is~only~found~with~'#2'~in~'enumext'.
  }
```

(*End of definition for* `keyans-wrong-level` *and* `wrong-place`.)

13.37.3 Storing content in prop list

`\__enumext_keyans_addto_prop:n`

The function `\__enumext_keyans_addto_prop:n` will pass the current ⟨*label*⟩ for `\item*` in `keyans` environment and the current ⟨*label*⟩ for `\anspic*` in `keyanspic` environment followed by the ⟨*contents*⟩ of the *optional argument* of both commands to the `\l__enumext_store_current_label_tl` variable, which will be stored to the *prop list* defined by the `save-ans` key using the function `\__enumext_store_addto_prop:V`.

```
\cs_new_protected:Nn \__enumext_keyans_addto_prop:n
  {
    \tl_clear:N \l__enumext_store_current_label_tl
    \int_compare:nNnTF { \l__enumext_keyans_pic_level_int } = { 1 }
      {
        \tl_put_right:Ne \l__enumext_store_current_label_tl { \l__enumext_label_vi_tl }
      }
      {
        \tl_put_right:Ne \l__enumext_store_current_label_tl { \l__enumext_label_v_tl }
      }
```

If the *optional argument* is present and the `save-sep` key is not empty, it is saved.

```
    \tl_if_novalue:nF {#1}
      {
        \tl_if_empty:NF \l__enumext_store_keyans_item_opt_sep_v_tl
          {
            \tl_put_right:NV \l__enumext_store_current_label_tl
              \l__enumext_store_keyans_item_opt_sep_v_tl
          }
        \tl_put_right:Nn \l__enumext_store_current_label_tl {#1}
      }
    \__enumext_store_addto_prop:V \l__enumext_store_current_label_tl
  }
```

(*End of definition for* `\__enumext_keyans_addto_prop:n`.)

13.37.4 The `save-ref` key for `keyans`, `keyans*` and `keyanspic`

The *"internal label and ref"* system for the `keyans`, `keyans*` and `keyanspic` environments has *slight differences* with the one implemented for `\anskey` basically because in this environments the interest is in the current ⟨*label*⟩ for `\item*` and `\anspic*` with the ⟨*contents*⟩ of the *optional argument*. The mechanism defined here allows executing `\ref{`⟨*store name : position*⟩`}` and will return `1.(A)`.

`\__enumext_keyans_store_ref:`
`\__enumext_keyans_store_ref_aux_i:`
`\__enumext_keyans_store_ref_aux_ii:`

The function `\__enumext_keyans_store_ref:` handles the *"internal label and ref"* system used by the `save-ref` key for `\item*` and `\anspic*` commands. First, copies of the current ⟨*labels*⟩ are created and the dots "`.`" are removed from them, since double dots in references are not wanted.

```
\cs_new_protected:Nn \__enumext_keyans_store_ref:
  {
    \bool_if:NT \l__enumext_store_ref_key_bool
      {
        \cs_set_protected:Nn \__enumext_tmp:n
          {
            \tl_set_eq:cc { l__enumext_label_copy_ ##1 _tl }
              { l__enumext_label_ ##1 _tl }
            \tl_reverse:c { l__enumext_label_copy_ ##1 _tl }
            \tl_remove_once:cn { l__enumext_label_copy_ ##1 _tl } { . }
            \tl_reverse:c { l__enumext_label_copy_ ##1 _tl }
          }
        \clist_map_inline:nn { i, v, vi, vii, viii } { \__enumext_tmp:n {##1} }
        \__enumext_keyans_store_ref_aux_i:
      }
  }
```

The auxiliary function __enumext_keyans_store_ref_aux_i: analyzes whether the environment in which it is executed is enumext* or enumext and sets the variable \l__enumext_newlabel_arg_one_tl, which will contain {⟨*store name* : *position*⟩}.

```
\cs_new_protected:Nn \__enumext_keyans_store_ref_aux_i:
  {
    \bool_if:NT \g__enumext_starred_bool
      {
        \tl_set_eq:NN \l__enumext_label_copy_i_tl \l__enumext_label_copy_vii_tl
      }
    \int_compare:nNnT { \l__enumext_keyans_pic_level_int } = { 1 }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          { \l__enumext_label_copy_i_tl . \l__enumext_label_copy_vi_tl }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_int } = { 1 }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          { \l__enumext_label_copy_i_tl . \l__enumext_label_copy_v_tl }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \tl_put_right:Ne \l__enumext_newlabel_arg_two_tl
          { \l__enumext_label_copy_i_tl . \l__enumext_label_copy_viii_tl }
      }
    \tl_put_right:Ne \l__enumext_newlabel_arg_one_tl
      {
        \l__enumext_store_name_tl \c_colon_str
        \int_eval:n { \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop } }
      }
    \__enumext_keyans_store_ref_aux_ii:
  }
```

Now the auxiliary function __enumext_keyans_store_ref_aux_ii: saves the result in the variable \l__enumext_write_aux_file_tl and finally writes it in the .aux file.

```
\cs_new_protected:Nn \__enumext_keyans_store_ref_aux_ii:
  {
    \tl_put_right:Ne \l__enumext_write_aux_file_tl
      {
        \__enumext_newlabel:nn
          { \exp_not:V \l__enumext_newlabel_arg_one_tl }
          { \l__enumext_newlabel_arg_two_tl }
      }
    \l__enumext_write_aux_file_tl
  }
```

(*End of definition for* __enumext_keyans_store_ref:, __enumext_keyans_store_ref_aux_i:, *and* __enumext_keyans_store_ref_aux_ii:.)

13.37.5 Storing content in sequence

__enumext_keyans_addto_seq:n
__enumext_keyans_addto_seq_link:

The function __enumext_keyans_addto_seq:n will pass the contents of the current ⟨*label*⟩ to the variable \l__enumext_store_current_label_tl. This is \l__enumext_label_v_tl for the keyans environment and \l__enumext_label_vi_tl for the keyanspic environment when using \item* and \anspic*, followed by the ⟨*contents*⟩ of the *optional argument* of both commands, and then to the sequence defined by the save-ans key.

```
\cs_new_protected:Nn \__enumext_keyans_addto_seq:n
  {
    \tl_clear:N \l__enumext_store_current_label_tl
    \int_compare:nNnTF { \l__enumext_keyans_pic_level_int } = { 1 }
      {
        \tl_put_right:Ne \l__enumext_store_current_label_tl
          { \item \l__enumext_label_vi_tl }
      }
      {
        \tl_put_right:Ne \l__enumext_store_current_label_tl
          { \item \l__enumext_label_v_tl }
      }
    \tl_if_novalue:nF {#1}
      {
        \tl_if_empty:NF \l__enumext_store_keyans_item_opt_sep_v_tl
```

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```
3627            {
3628              \tl_put_right:NV \l__enumext_store_current_label_tl
3629                \l__enumext_store_keyans_item_opt_sep_v_tl
3630            }
3631          \tl_put_right:Nn \l__enumext_store_current_label_tl {#1}
3632        }
3633      \__enumext_keyans_addto_seq_link:
3634    }
```

Checks if the save-ref key is active along with the hyperref package load, if both conditions are met, it will create the \hyperlink and then store using the __enumext_store_addto_seq:V function. Finally, when the check-ans key is active, it increments the value of the integer variable \g__enumext_item_anskey_int.

```
3635 \cs_new_protected:Nn \__enumext_keyans_addto_seq_link:
3636   {
3637     \bool_lazy_and:nnT
3638       { \bool_if_p:N \l__enumext_store_ref_key_bool }
3639       { \bool_if_p:N \l__enumext_hyperref_bool }
3640       {
3641         \tl_put_right:Ne \l__enumext_store_current_label_tl
3642           {
3643             \hfill \exp_not:N \hyperlink
3644               {
3645                 \exp_not:V \l__enumext_newlabel_arg_one_tl
3646               }
3647               { \exp_not:V \l__enumext_mark_ref_sym_tl }
3648           }
3649       }
3650     \__enumext_store_addto_seq:V \l__enumext_store_current_label_tl
3651     \bool_if:NT \l__enumext_check_answers_bool
3652       {
3653         \int_gincr:N \g__enumext_item_anskey_int
3654       }
3655   }
```

(*End of definition for* __enumext_keyans_addto_seq:n *and* __enumext_keyans_addto_seq_link:.)

13.37.6 The show-ans and show-pos keys for keyans and keyanspic

__enumext_keyans_save_item_opt:n
__enumext_keyans_show_item_opt:
__enumext_keyans_show_item_opt_viii:

The function __enumext_keyans_save_item_opt:n will save the optional argument of \item* and \anspic* in the variable \l__enumext_store_current_opt_arg_tl.

```
3656 \cs_new_protected:Nn \__enumext_keyans_save_item_opt:n
3657   {
3658     \tl_if_novalue:nF {#1}
3659       {
3660         \tl_set:Nn \l__enumext_store_current_opt_arg_tl {#1}
3661       }
3662   }
```

The function __enumext_keyans_show_item_opt: will print the optional arguments of \item* and \anspic* when the show-ans or show-pos keys are set next to the key wrap-opt in keyans and keyanspic environments.

```
3663 \cs_new_protected:Nn \__enumext_keyans_show_item_opt:
3664   {
3665     \tl_if_empty:NF \l__enumext_store_current_opt_arg_tl
3666       {
3667         \bool_lazy_or:nnT
3668           { \bool_if_p:N \l__enumext_show_answer_bool }
3669           { \bool_if_p:N \l__enumext_show_position_bool }
3670           {
3671             \__enumext_keyans_wrapper_opt_v:n
3672               { \l__enumext_store_current_opt_arg_tl } \c_space_tl
3673           }
3674       }
3675   }
```

The function __enumext_keyans_show_item_opt_viii: will print the optional argument of \item* when the show-ans or show-pos keys are set next to the key wrap-opt in keyans* environment.

```
3676 \cs_new_protected:Nn \__enumext_keyans_show_item_opt_viii:
3677   {
```

```
    \tl_if_empty:NF \l__enumext_store_current_opt_arg_tl
      {
        \bool_lazy_or:nnT
          { \bool_if_p:N \l__enumext_show_answer_bool }
          { \bool_if_p:N \l__enumext_show_position_bool }
          {
            \__enumext_keyans_wrapper_opt_viii:n
              { \l__enumext_store_current_opt_arg_tl } \c_space_tl
          }
      }
  }
```

(*End of definition for* `\__enumext_keyans_save_item_opt:n`, `\__enumext_keyans_show_item_opt:`, *and* `\__enumext_keyans_show_item_opt_viii:`.)

`\__enumext_keyans_pos_mark_set:`
`\__enumext_keyans_show_ans:`
`\__enumext_keyans_show_pos:`

The function `\__enumext_keyans_pos_mark_set:` adjusts the horizontal spaces for the `mark-sep*` key taking into account the value of the `align` key and the width of ⟨*label*⟩.

```
\cs_new_protected:Nn \__enumext_keyans_pos_mark_set:
  {
    \__enumext_label_width_by_box:Nn
      \l__enumext_mark_sep_tmpa_dim { \l__enumext_label_v_tl }
    \str_case:Vn \l__enumext_align_label_pos_v_str
      {
        { l }
          {
            \dim_set:Nn \l__enumext_mark_sep_tmpb_dim { \c_zero_dim }
          }
        { r }
          {
            \dim_set:Nn \l__enumext_mark_sep_tmpb_dim
              { \l__enumext_labelwidth_v_dim - \l__enumext_mark_sep_tmpa_dim }
          }
        { c }
          {
            \dim_set:Nn \l__enumext_mark_sep_tmpb_dim
              { 0.5\l__enumext_labelwidth_v_dim - 0.5\l__enumext_mark_sep_tmpa_dim }
          }
      }
```

Sets the default values for the keys `mark-ans*`, `mark-sep*` and `mark-pos*`.

```
    \dim_compare:nNnT { \l__enumext_mark_sym_sep_v_dim } = { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_mark_sym_sep_v_dim { \l__enumext_labelsep_v_dim }
      }
    \tl_set_eq:NN \l__enumext_mark_answer_sym_tl \l__enumext_mark_answer_sym_v_tl
    \dim_add:Nn \l__enumext_mark_sym_sep_v_dim { \l__enumext_mark_sep_tmpb_dim }
    \str_set_eq:NN \l__enumext_mark_position_str \l__enumext_mark_position_v_str
  }
```

The function `\__enumext_keyans_show_ans:` will print the ⟨*symbol*⟩ set by the `mark-ans*` key when the `show-ans` key is active.

```
\cs_new_protected:Nn \__enumext_keyans_show_ans:
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_show_answer_bool   }
        { \bool_if_p:N \l__enumext_item_wrap_key_bool }
      }
      {
        \__enumext_keyans_pos_mark_set:
        \__enumext_print_keyans_box:NN
          \l__enumext_labelwidth_v_dim \l__enumext_mark_sym_sep_v_dim
      }
  }
```

The function `\__enumext_keyans_show_pos:` will print the ⟨*position*⟩ of the stored content in *prop list*. It is the number of elements of the prop list plus the value of `\l__enumext_show_pos_tmp_int`, which is incremented in each execution inside `keyans` and is zero in the other environments.

```
\cs_new_protected:Nn \__enumext_keyans_show_pos:
```

```
{
  \int_compare:nNnTF { \l__enumext_keyans_level_int } = { 1 }
    {
      \int_incr:N \l__enumext_show_pos_tmp_int
    }
    {
      \int_zero:N \l__enumext_show_pos_tmp_int
    }
  \bool_lazy_all:nT
    {
      { \bool_if_p:N \l__enumext_show_position_bool }
      { \bool_if_p:N \l__enumext_item_wrap_key_bool }
    }
    {
      \tl_set:Ne \l__enumext_mark_answer_sym_v_tl
        {
          \group_begin:
            \exp_not:N \normalfont
            \exp_not:N \footnotesize [ \int_eval:n
              {
                \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop }
                + \l__enumext_show_pos_tmp_int
              }
            ]
          \group_end:
        }
      \__enumext_keyans_pos_mark_set:
      \__enumext_print_keyans_box:NN
        \l__enumext_labelwidth_v_dim \l__enumext_mark_sym_sep_v_dim
    }
}
```

(*End of definition for* `\__enumext_keyans_pos_mark_set:`, `\__enumext_keyans_show_ans:`, *and* `\__enumext_keyans_show_pos:`.)

13.38 Redefining `\item` and `\makelabel` in enumext

Redefining the `\item` command is not as simple as it seems. This command works in conjunction with the `\makelabel` command, so both of them have to be redefined; in addition, a couple of *global* variables are needed to pass the values from one command to the other.

When *tagged* PDF is active `\makelabel` is redefined as `\hss #1` and the only way to get the `align` key to work correctly is to redefine `\makelabel` using `\makebox`. The best way to implement this is to use the conditional command `\IfDocumentMetadataTF` to force this redefinition and the dedicated `mode-box` key to manually activate it by the user.

The `\item` and `\item[`⟨*custom*⟩`]` commands work in the usual way on `enumext`, and `\item*`, `\item*[`⟨*symbol*⟩`]` and `\item*[`⟨*symbol*⟩`][`⟨*offset*⟩`]` are added.

`\g__enumext_item_symbol_aux_tl` Internal variable used by `item-sym*` key (§13.39).

```
\tl_new:N \g__enumext_item_symbol_aux_tl
```

(*End of definition for* `\g__enumext_item_symbol_aux_tl`.)

`\__enumext_default_item:n` First it checks if the *optional argument* is present. If it is NOT present, it checks the state of the variable `\l__enumext_check_answers_bool` set by the key `no-store`, and then sets the boolean variable `\l__enumext_wrap_label_X_bool` to `true` for the key `wrap-label`. After that it executes `\__enumext_item_std:w` and the key `itemindent`. Otherwise it checks the state of the boolean variable `\l__enumext_wrap_label_opt_X_bool` set by the key `wrap-label*`, and executes `\__enumext_item_std:w` with the *optional argument* and the key `itemindent`.

```
\cs_new_protected:Nn \__enumext_default_item:n
  {
    \tl_if_novalue:nTF {#1}
      {
        \bool_if:NT \l__enumext_check_answers_bool
          {
            \int_gincr:N \g__enumext_item_number_int
            \bool_set_true:N \l__enumext_item_number_bool
          }
        \bool_set_true:c { l__enumext_wrap_label_ \__enumext_level: _bool }
        \__enumext_item_std:w
```

```
3775            \tl_use:c { l__enumext_fake_item_indent_ \__enumext_level: _tl }
3776          }
3777          {
3778            \bool_set_eq:cc
3779              { l__enumext_wrap_label_ \__enumext_level: _bool }
3780              { l__enumext_wrap_label_opt_ \__enumext_level: _bool }
3781            \__enumext_item_std:w [#1]
3782              \tl_use:c { l__enumext_fake_item_indent_ \__enumext_level: _tl }
3783          }
3784      }
```

(*End of definition for* `\__enumext_default_item:n`.)

`\__enumext_item_starred_exec:nn`
`\__enumext_item_starred_exec:`

The `\item*`, `\item*[`⟨*symbol*⟩`]` and `\item*[`⟨*symbol*⟩`][`⟨*offset*⟩`]` work like the *numbered* `\item`, but placing a ⟨*symbol*⟩ to the *"left"* of the ⟨*label*⟩ separated from it by the value of the second *optional argument* ⟨*offset*⟩.

`#1` : `\l__enumext_item_symbol_X_tl`
`#2` : `\l__enumext_item_symbol_sep_X_dim`

First a copy of `\l__enumext_item_symbol_X_tl` is made, which is set by the key `item-sym*` or passed as *"first" optional argument* in the global variable `\g__enumext_item_symbol_aux_tl`, followed by setting the variable `\l__enumext_item_symbol_sep_X_dim` set by the key `item-pos*` or by the *"second" optional argument*, then the state of the variable `\l__enumext_check_answers_bool` set by the key `no-store` is checked, the boolean variable `\l__enumext_wrap_label_X_bool` is set to `true` for the key `wrap-label` and `\__enumext_item_std:w` and the key `itemindent` are executed.

```
3785  \cs_new_protected:Nn \__enumext_item_starred_exec:nn
3786    {
3787      \tl_if_novalue:nTF {#1}
3788        {
3789          \tl_gset_eq:Nc
3790            \g__enumext_item_symbol_aux_tl
3791              { l__enumext_item_symbol_ \__enumext_level: _tl }
3792        }
3793        {
3794          \tl_gset:Nn \g__enumext_item_symbol_aux_tl {#1}
3795        }
3796      \tl_if_novalue:nTF {#2}
3797        {
3798          \dim_set_eq:cc
3799            { l__enumext_item_symbol_sep_ \__enumext_level: _dim }
3800            { l__enumext_labelsep_ \__enumext_level: _dim }
3801        }
3802        {
3803          \dim_set:cn { l__enumext_item_symbol_sep_ \__enumext_level: _dim } {#2}
3804        }
3805      \bool_if:NT \l__enumext_check_answers_bool
3806        {
3807          \int_gincr:N \g__enumext_item_number_int
3808          \bool_set_true:N \l__enumext_item_number_bool
3809        }
3810      \bool_set_true:c { l__enumext_wrap_label_ \__enumext_level: _bool }
3811      \__enumext_item_std:w
3812        \tl_use:c { l__enumext_fake_item_indent_ \__enumext_level: _tl }
3813    }
```

The function `\__enumext_item_starred_exec:` will be responsible for executing `\item*` for the `enumext` environment.

```
3814  \cs_new_protected:Nn \__enumext_item_starred_exec:
3815    {
3816      \tl_if_empty:cF { l__enumext_item_symbol_ \__enumext_level: _tl }
3817        {
3818          \mode_leave_vertical:
3819          \skip_horizontal:n { -\dim_use:c { l__enumext_item_symbol_sep_
3820            \__enumext_level: _dim } }
3821          \hbox_overlap_left:n { \g__enumext_item_symbol_aux_tl }
3822          \skip_horizontal:n { \dim_use:c { l__enumext_item_symbol_sep_
3823            \__enumext_level: _dim } }
3824        }
3825    }
```

(*End of definition for* `\__enumext_item_starred_exec:nn` *and* `\__enumext_item_starred_exec:`.)

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__enumext_redefine_item:

The function __enumext_redefine_item: will redefine the \item command in the enumext environment adding \item*. This function is passed to __enumext_list_arg_two_X: used in the definition of the enumext environment (§13.43).

```
\cs_new_protected:Nn \__enumext_redefine_item:
  {
    \RenewDocumentCommand \item { s o o }
      {
        \bool_if:nTF {##1}
          {
            \__enumext_item_starred_exec:nn {##2} {##3}
          }
          { \__enumext_default_item:n {##2} }
      }
  }
```

(*End of definition for* __enumext_redefine_item:.)

__enumext_make_label:
__enumext_make_label_std:
__enumext_make_label_box:

The function __enumext_make_label: redefines \makelabel for the keys mode-box, align, font, wrap-label, wrap-label* and \item* for the enumext environment. This function is passed to __enumext_list_arg_two_X:, used in the definition of the enumext environment (§13.43).

```
\cs_new_protected:Nn \__enumext_make_label:
  {
    \IfDocumentMetadataTF
      {
        \__enumext_make_label_box:
      }
      {
        \bool_if:NTF \l__enumext_mode_box_bool
          {
            \__enumext_make_label_box:
          }
          {
            \__enumext_make_label_std:
          }
      }
  }
```

Standard definition when \DocumentMetadata is not active.

```
\cs_new_protected:Nn \__enumext_make_label_std:
  {
    \RenewDocumentCommand \makelabel { m }
      {
        \tl_use:c { l__enumext_label_fill_left_ \__enumext_level: _tl }
        \__enumext_item_starred_exec:
        \tl_use:c { l__enumext_label_font_style_ \__enumext_level: _tl }
        \bool_if:cTF { l__enumext_wrap_label_ \__enumext_level: _bool }
          {
            \use:c { __enumext_wrapper_label_ \__enumext_level: :n } {##1}
          }
          {##1}
        \tl_use:c { l__enumext_label_fill_right_ \__enumext_level: _tl }
        \tl_gclear:N \g__enumext_item_symbol_aux_tl
      }
  }
```

Definition using \makebox when \DocumentMetadata is active or mode-box is active.

The label is not smashed, so a tall label (an image, a duck drawn with tikz, ...) still increases the height of the line as it does with the standard \makelabel. A multi-line label made with \parbox[t] needs \noindent at the start of the paragraph (see \labelbx in §9), otherwise the *tagged* PDF code puts material before the first line and the baseline is lost.

```
\cs_new_protected:Nn \__enumext_make_label_content:n
  {
    \__enumext_item_starred_exec:
    \tl_use:c { l__enumext_label_font_style_ \__enumext_level: _tl }
    \bool_if:cTF { l__enumext_wrap_label_ \__enumext_level: _bool }
      { \use:c { __enumext_wrapper_label_ \__enumext_level: :n } {#1} }
      {#1}
  }
```

The label is measured first (with *tagged* PDF suspended) so that the box is never narrower than the label itself, as in the standard \makelabel.

```
\cs_new_protected:Nn \__enumext_make_label_box:
  {
    \RenewDocumentCommand \makelabel { m }
      {
        \hbox_set:Nn \l__enumext_label_width_by_box
          {
            \IfDocumentMetadataT { \SuspendTagging { enumext } }
            \__enumext_make_label_content:n {##1}
          }
        \makebox
          [ \dim_max:nn
              { \dim_use:c { l__enumext_labelwidth_ \__enumext_level: _dim } }
              { \box_wd:N \l__enumext_label_width_by_box } ]
          [ \str_use:c { l__enumext_align_label_pos_ \__enumext_level: _str } ]
          { \__enumext_make_label_content:n {##1} }
        \tl_gclear:N \g__enumext_item_symbol_aux_tl
      }
  }
```

(*End of definition for* __enumext_make_label:, __enumext_make_label_std:, *and* __enumext_make_label_box:.)

13.39 Setting item-sym* and item-pos* keys

In order to have a cleaner implementation of \item* for the enumext and enumext* environments it is best to define a couple of keys that allow controlling and setting by default the ⟨*symbol*⟩ and its ⟨*offset*⟩.

item-sym*
item-pos*

Define and set item-sym* and item-pos* keys for enumext and enumext*.

```
\cs_set_protected:Nn \__enumext_tmp:nn
  {
    \keys_define:nn { enumext / #1 }
      {
        item-sym* .tl_set:c = { l__enumext_item_symbol_ #2 _tl },
        item-sym* .value_required:n = true,
        item-sym* .initial:n = {\textborn},
        item-pos* .dim_set:c = { l__enumext_item_symbol_sep_ #2 _dim },
        item-pos* .value_required:n = true,
      }
  }
\clist_map_inline:nn
  {
    {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv}, {enumext*}{vii}
  }
  { \__enumext_tmp:nn #1 }
```

(*End of definition for* item-sym* *and* item-pos*.)

13.40 Handling unknown keys

At this point in the code no more ⟨*keys*⟩ will be added. Since the definitions of environments and commands have already been quite *restrictive*, the only thing left to do is to be equally strict with the ⟨*keys*⟩ (consistency matters).

Well, the paragraph above did not hold entirely: more ⟨*keys*⟩ had to be added than planned, and not everything turns out as expected.

13.40.1 Definition of error messages

starred-unknown-key
starred-unknown-key-value

Message used by unknown ⟨*keys*⟩ in enumext* environment.

```
\msg_new:nnnn { enumext } { starred-unknown-key }
  {
    The~key~'#1'~is~unknown~by~environment~
    '\l__enumext_envir_name_tl'~and~is~being~ignored~\msg_line_context:.
  }
  {
    The~environment~'\l__enumext_envir_name_tl'~does~not~
    have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { starred-unknown-key-value }
```

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```
    {
      The~key~'#1=#2'~is~unknown~by~environment~
      '\l__enumext_envir_name_tl'~and~is~being~ignored~\msg_line_context:.
    }
    {
      The~environment~'\l__enumext_envir_name_tl'~does~not~
      have~a~key~called~'#1'.~
      Check~that~you~have~spelled~the~key~name~correctly.
    }
```

(*End of definition for* `starred-unknown-key` *and* `starred-unknown-key-value`.)

`standard-unknown-key`
`standard-unknown-key-value`

Message used by unknown ⟨*keys*⟩ in `enumext` environment.

```
\msg_new:nnnn { enumext } { standard-unknown-key }
  {
    The~key~'#1'~is~unknown~by~environment~'\l__enumext_envir_name_tl'~on~level~
    \int_use:N \l__enumext_level_int \c_space_tl and~is~being~ignored~
    \msg_line_context:.
  }
  {
    The~environment~'\l__enumext_envir_name_tl'~does~not~
    have~a~key~called~'#1'~on~level~\int_use:N \l__enumext_level_int.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { standard-unknown-key-value }
  {
    The~key~'#1=#2'~is~unknown~by~environment~'\l__enumext_envir_name_tl'~on~level~
    \int_use:N \l__enumext_level_int \c_space_tl and~is~being~ignored~
    \msg_line_context:.
  }
  {
    The~environment~'\l__enumext_envir_name_tl'~does~not~
    have~a~key~called~'#1'~on~level~\int_use:N \l__enumext_level_int.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
```

(*End of definition for* `standard-unknown-key` *and* `standard-unknown-key-value`.)

`keyans-unknown-key`
`keyans-unknown-key-value`

Message used by unknown ⟨*keys*⟩ in `keyans`, `keyans*` and `keyanspic` environments.

```
\msg_new:nnnn { enumext } { keyans-unknown-key }
  {
    The~key~'#1'~is~unknown~by~environment~
    '\l__enumext_envir_name_tl'~and~is~being~ignored~\msg_line_context:.
  }
  {
    The~environment~'\l__enumext_envir_name_tl'~does~not~
    have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { keyans-unknown-key-value }
  {
    The~key~'#1=#2'~is~unknown~by~environment~
    '\l__enumext_envir_name_tl'~and~is~being~ignored~\msg_line_context:.
  }
  {
    The~environment~'\l__enumext_envir_name_tl'~does~not~
    have~a~key~called~'#1'.~
    Check~that~you~have~spelled~the~key~name~correctly.
  }
```

(*End of definition for* `keyans-unknown-key` *and* `keyans-unknown-key-value`.)

13.40.2 Handling unknown keys for keyans, keyans* and keyanspic

`unknown`
`\__enumext_keyans_unknown_keys:n`
`\__enumext_keyans_unknown_keys:nn`
`\__enumext_keyans_unknown_keys:Vn`

Define and set `unknown` key for `keyans`, `keyans*` and `keyanspic` environments. Here it is necessary to set `\l__enumext_envir_name_tl` in case an `unknown` key is passed using `\setenumext`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / #1 }
      {
```

```
      unknown .code:n =
        {
          \tl_set:Nn \l__enumext_envir_name_tl {#1}
          \__enumext_keyans_unknown_keys:n {##1}
        },
    }
}
\clist_map_inline:nn { keyans, keyans*, keyanspic } { \__enumext_tmp:n {#1} }
```

Internal functions for handling unknown key.

```
\cs_new_protected:Nn \__enumext_keyans_unknown_keys:n
  {
    \__enumext_keyans_unknown_keys:Vn \l_keys_key_str {#1}
  }
\cs_new_protected:Nn \__enumext_keyans_unknown_keys:nn
  {
    \tl_if_blank:nTF {#2}
      {
        \msg_error:nne { enumext } { keyans-unknown-key } {#1}
      }
      {
        \msg_error:nnee { enumext } { keyans-unknown-key-value } {#1} {#2}
      }
  }
\cs_generate_variant:Nn \__enumext_keyans_unknown_keys:nn { V }
```

(*End of definition for* unknown , __enumext_keyans_unknown_keys:n , *and* __enumext_keyans_unknown_keys:nn.)

13.40.3 Handling unknown keys for enumext*

unknown

Define and set unknown key for enumext* environment.

```
\keys_define:nn { enumext / enumext* }
  {
    unknown .code:n =
      {
        \tl_set:Ne \l__enumext_envir_name_tl { enumext* }
        \__enumext_starred_unknown_keys:n {#1}
      },
  }
```

(*End of definition for* unknown.)

__enumext_starred_unknown_keys:n
__enumext_starred_unknown_keys:nn
__enumext_starred_unknown_keys:Vn

Internal functions for handling unknown key.

```
\cs_new_protected:Nn \__enumext_starred_unknown_keys:n
  {
    \__enumext_starred_unknown_keys:Vn \l_keys_key_str {#1}
  }
\cs_new_protected:Nn \__enumext_starred_unknown_keys:nn
  {
    \tl_if_blank:nTF {#2}
      {
        \msg_error:nne { enumext } { starred-unknown-key } {#1}
      }
      {
        \msg_error:nnee { enumext } { starred-unknown-key-value } {#1} {#2}
      }
  }
\cs_generate_variant:Nn \__enumext_starred_unknown_keys:nn { V }
```

(*End of definition for* __enumext_starred_unknown_keys:n *and* __enumext_starred_unknown_keys:nn.)

13.40.4 Handling unknown keys for enumext

unknown
__enumext_standard_unknown_keys:n
__enumext_standard_unknown_keys:nn
__enumext_standard_unknown_keys:Vn

Defines and sets the key unknown for enumext environment.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \keys_define:nn { enumext / level-#1 }
      {
        unknown .code:n =
          {
```

```
4029              \int_set:Nn \l__enumext_level_int {#1}
4030              \tl_set:Ne \l__enumext_envir_name_tl { enumext }
4031              \__enumext_standard_unknown_keys:n {##1}
4032            },
4033        }
4034    }
4035 \clist_map_inline:nn {1, 2, 3, 4} { \__enumext_tmp:n {#1} }
```

Internal functions for handling unknown key.

```
4036 \cs_new_protected:Nn \__enumext_standard_unknown_keys:n
4037   {
4038     \__enumext_standard_unknown_keys:Vn \l_keys_key_str {#1}
4039   }
4040 \cs_new_protected:Nn \__enumext_standard_unknown_keys:nn
4041   {
4042     \tl_if_blank:nTF {#2}
4043       {
4044         \msg_error:nne { enumext } { standard-unknown-key } {#1}
4045       }
4046       {
4047         \msg_error:nnee { enumext } { standard-unknown-key-value } {#1} {#2}
4048       }
4049   }
4050 \cs_generate_variant:Nn \__enumext_standard_unknown_keys:nn { V }
```

(*End of definition for* unknown , `\__enumext_standard_unknown_keys:n` , *and* `\__enumext_standard_unknown_keys:nn`.)

13.41 Redefining `\item` and `\makelabel` in keyans

The `\item` and `\item[`⟨*custom*⟩`]` commands work in the usual way in keyans, but the `\item*` and `\item*[`⟨*content*⟩`]` commands *store* the current ⟨*label*⟩ next to the ⟨*content*⟩ if it is present in the *sequence* and *prop list* defined by save-ans key.

`\__enumext_keyans_default_item:n` The function `\__enumext_keyans_default_item:n` executes the original behavior of the `\item` along with the keys wrap-label, wrap-label* and itemindent.

```
4051 \cs_new_protected:Nn \__enumext_keyans_default_item:n
4052   {
4053     \tl_if_novalue:nTF {#1}
4054       {
4055         \bool_set_true:N \l__enumext_wrap_label_v_bool
4056         \__enumext_item_std:w \tl_use:N \l__enumext_fake_item_indent_v_tl
4057       }
4058       {
4059         \bool_set_eq:NN \l__enumext_wrap_label_v_bool \l__enumext_wrap_label_opt_v_bool
4060         \__enumext_item_std:w [#1] \tl_use:N \l__enumext_fake_item_indent_v_tl
4061       }
4062   }
```

(*End of definition for* `\__enumext_keyans_default_item:n`.)

`\__enumext_keyans_starred_item:n` The function `\__enumext_keyans_starred_item:n` will take as argument '`#1`' the *optional argument* `[`⟨*content*⟩`]` passed to `\item*` and save it via the `\__enumext_keyans_save_item_opt:n` function, then activate the wrap-label key, execute `\item` using `\__enumext_item_std:w`, the itemindent key and print the *optional argument* using the `\__enumext_keyans_show_item_opt:` function handled by the wrap-opt key.

```
4063 \cs_new_protected:Nn \__enumext_keyans_starred_item:n
4064   {
4065     \__enumext_keyans_save_item_opt:n {#1}
4066     \bool_set_true:N \l__enumext_wrap_label_v_bool
4067     \__enumext_item_std:w \tl_use:N \l__enumext_fake_item_indent_v_tl
4068     \__enumext_keyans_show_item_opt:
```

Now *store* the current ⟨*label*⟩ first in the *prop list* (including the *optional argument*), run the internal *"label and ref"* system if the save-ref key is active, then *store* in the *sequence* and finally it increments `\g__enumext_check_starred_cmd_int` for internal check system.

```
4069     \__enumext_keyans_addto_prop:n {#1}
4070     \__enumext_keyans_store_ref:
4071     \__enumext_keyans_addto_seq:n {#1}
4072     \int_gincr:N \g__enumext_check_starred_cmd_int
4073   }
```

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(*End of definition for* `\__enumext_keyans_starred_item:n`.)

`\item*`
`\__enumext_keyans_redefine_item:`

The function `\__enumext_keyans_redefine_item:` is responsible for adding the *starred argument* and *optional argument* by the `\__enumext_list_arg_two_v:` function in the definition of the `keyans` environment. Here the variable `\l__enumext_item_wrap_key_bool` used by the `wrap-ans*` key is set to true only when `\item*` is executed and, additionally, it is necessary to use `\peek_remove_spaces:n` to avoid an unwanted space when using `\item*` together with the `itemindent` key. This function is passed to `\__enumext_list_arg_two_v:` used in the definition of the `keyans` environment (§13.42).

```
\cs_new_protected:Nn \__enumext_keyans_redefine_item:
  {
    \RenewDocumentCommand \item { s o }
      {
        \bool_if:nTF {##1}
          {
            \bool_set_true:N \l__enumext_item_wrap_key_bool % wrap-ans*
            \peek_remove_spaces:n
              {
                \__enumext_keyans_starred_item:n {##2}
              }
          }
          {
            \bool_set_false:N \l__enumext_item_wrap_key_bool
            \__enumext_keyans_default_item:n {##2}
          }
      }
  }
```

(*End of definition for* `\item*` *and* `\__enumext_keyans_redefine_item:`. *This function is documented on page 6.*)

`\__enumext_keyans_make_label:`
`\__enumext_keyans_wrapper_label:n`
`\__enumext_keyans_make_label_std:`
`\__enumext_keyans_make_label_box:`
`\__enumext_wrapper_label_v:n`

The function `\__enumext_keyans_make_label:` redefines `\makelabel` for the keys `mode-box`, `align`, `font`, `wrap-label`, `wrap-label*`, `wrap-ans*` and `\item*` for `keyans` environment. This function is passed to `\__enumext_list_arg_two_v:` used in the definition of the `keyans` environment (§13.42).

```
\cs_new_protected:Nn \__enumext_keyans_make_label:
  {
    \IfDocumentMetadataTF
      {
        \__enumext_keyans_make_label_box:
      }
      {
        \bool_if:NTF \l__enumext_mode_box_bool
          {
            \__enumext_keyans_make_label_box:
          }
          {
            \__enumext_keyans_make_label_std:
          }
      }
  }
```

Conditionals are added to the `\__enumext_keyans_wrapper_label:n` function to handle the keys `wrap-ans*`, `wrap-label` and `wrap-label*`.

```
\cs_new_protected:Nn \__enumext_keyans_wrapper_label:n
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_wrap_label_v_bool         }
        { \bool_if_p:N \l__enumext_show_answer_bool          }
        { \bool_if_p:N \l__enumext_item_wrap_key_bool        }
        { \cs_if_exist_p:N \__enumext_keyans_wrapper_item_v:n }
      }
      {
        \cs_set_eq:NN \__enumext_wrapper_label_v:n \__enumext_keyans_wrapper_item_v:n
      }
    \bool_if:NTF \l__enumext_wrap_label_v_bool
      {
        \__enumext_wrapper_label_v:n {#1}
      }
      {#1}
  }
```

Standard definition when \DocumentMetadata is not active.

```
\cs_new_protected:Nn \__enumext_keyans_make_label_std:
  {
    \RenewDocumentCommand \makelabel { m }
      {
        \tl_use:N \l__enumext_label_fill_left_v_tl
        \__enumext_keyans_show_ans:
        \__enumext_keyans_show_pos:
        \tl_use:N \l__enumext_label_font_style_v_tl
        \__enumext_keyans_wrapper_label:n {##1}
        \tl_use:N \l__enumext_label_fill_right_v_tl
      }
  }
```

Definition using \makebox when \DocumentMetadata is active or mode-box is active.

```
\cs_new_protected:Nn \__enumext_keyans_make_label_content:n
  {
    \__enumext_keyans_show_ans:
    \__enumext_keyans_show_pos:
    \tl_use:N \l__enumext_label_font_style_v_tl
    \__enumext_keyans_wrapper_label:n {#1}
  }
\cs_new_protected:Nn \__enumext_keyans_make_label_box:
  {
    \RenewDocumentCommand \makelabel { m }
      {
        \hbox_set:Nn \l__enumext_label_width_by_box
          {
            \IfDocumentMetadataT { \SuspendTagging { enumext } }
            \__enumext_keyans_make_label_content:n {##1}
          }
        \makebox
          [ \dim_max:nn
              { \l__enumext_labelwidth_v_dim }
              { \box_wd:N \l__enumext_label_width_by_box } ]
          [ \l__enumext_align_label_pos_v_str ]
          { \__enumext_keyans_make_label_content:n {##1} }
      }
  }
```

(*End of definition for* `\__enumext_keyans_make_label:` *and others.*)

13.42 Second argument of the lists

At this point in the code most of the tools needed to create a *custom* list environment have already been programmed. Remember that the __enumext_start_list:nn function takes two arguments: the "first" one is ready, and the "second" one is defined for all levels of the enumext environment, the keyans environment and the enumext* and keyans* environments.

Here the __enumext_list_arg_two_X: function is implemented, which is responsible for setting all the list parameters, the counter, the redefinition of \item, \makelabel along with the keys ref, itemindent and show-length.

13.42.1 Definition of variables

\l__enumext_itemindent_X_dim

The function __enumext_calc_hspace:NNNNNNN sets the dimension \l__enumext_itemindent_X_dim (§13.42.4).

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \dim_new:c { l__enumext_itemindent_ #1 _dim }
  }
\clist_map_inline:nn { i, ii, iii, iv, v, vi, vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_itemindent_X_dim`.)

13.42.2 Definition of error messages

width-negative

Messages used in length calculation.

```
\msg_new:nnn { enumext } { width-negative }
  {
    Ignoring~negative~value~'#1=#2'~\msg_line_context:.\\
    The~key~'#1'~accepts~values~>=~0pt.
  }
```

(*End of definition for* `width-negative`.)

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13.42.3 Definition of messages for the show-length key

The messages that print the lengths of the lists to the terminal; they are not error messages.

list-lengths Messages used by show-length key in enumext.

```
\msg_new:nnn { enumext } { list-lengths }
  {
    ****~Lengths~used~by~'enumext'~level~'#2'~
    \msg_line_context:~\c_space_tl ****\\
    \__enumext_show_length:nnn { dim  } { labelsep      } {#1}
    \__enumext_show_length:nnn { dim  } { labelwidth    } {#1}
    \__enumext_show_length:nnn { dim  } { itemindent    } {#1}
    \__enumext_show_length:nnn { dim  } { leftmargin    } {#1}
    \__enumext_show_length:nnn { dim  } { rightmargin   } {#1}
    \__enumext_show_length:nnn { dim  } { listparindent } {#1}
    \__enumext_show_length:nnn { skip } { topsep        } {#1}
    \__enumext_show_length:nnn { skip } { parsep        } {#1}
    \__enumext_show_length:nnn { skip } { partopsep     } {#1}
    \__enumext_show_length:nnn { skip } { itemsep       } {#1}
    **************************************************
  }
```

(*End of definition for* list-lengths.)

list-lengths-not-nested Messages used by show-length key in enumext*, keyans* and keyans.

```
\msg_new:nnn { enumext } { list-lengths-not-nested }
  {
    ****~Lengths~used~by~'#2'~environment~
    \msg_line_context:~\c_space_tl ****\\
    \__enumext_show_length:nnn { dim  } { labelsep      } {#1}
    \__enumext_show_length:nnn { dim  } { labelwidth    } {#1}
    \__enumext_show_length:nnn { dim  } { itemindent    } {#1}
    \__enumext_show_length:nnn { dim  } { leftmargin    } {#1}
    \__enumext_show_length:nnn { dim  } { rightmargin   } {#1}
    \__enumext_show_length:nnn { dim  } { listparindent } {#1}
    \__enumext_show_length:nnn { skip } { topsep        } {#1}
    \__enumext_show_length:nnn { skip } { parsep        } {#1}
    \__enumext_show_length:nnn { skip } { partopsep     } {#1}
    \__enumext_show_length:nnn { skip } { itemsep       } {#1}
    **************************************************
  }
```

(*End of definition for* list-lengths-not-nested.)

13.42.4 Calculation of \leftmargin and \itemindent

Consider the figure 9 where the default margins (on the left) of a list are represented.

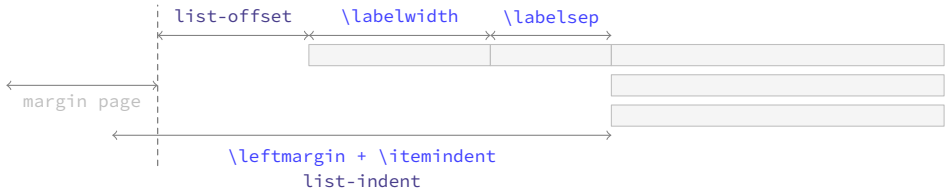

Figure 9: Representation of standard horizontal lengths in list environment.

The idea is to have control over these margins so that the list does not overlap the left margin of the page. The *key* relationship is that the *"right edge"* of the \labelsep equals the *"right edge"* of the \itemindent, so that the left edge of the *"label box"* is at \leftmargin+\itemindent minus \labelwidth+\labelsep. Thus, the handling of the margins by the package will be as shown in the figure 10.

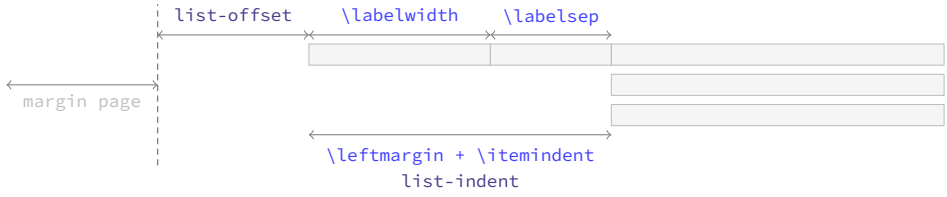

Figure 10: Representation of horizontal lengths concept in list in enumext.

Where the default values will look like in the figure 11.

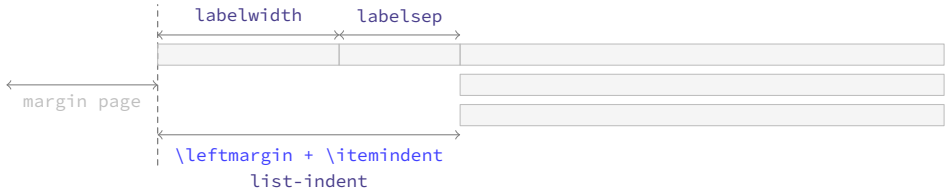

Figure 11: Default horizontal lengths in enumext.

__enumext_calc_hspace:NNNNNNN
__enumext_calc_hspace:ccccccc

The function __enumext_calc_hspace:NNNNNNN takes seven arguments to be able to determine horizontal spaces for all list environment:

#1 : \l__enumext_labelwidth_X_dim
#2 : \l__enumext_labelsep_X_dim
#3 : \l__enumext_listoffset_X_dim
#4 : \l__enumext_leftmargin_tmp_X_dim
#5 : \l__enumext_leftmargin_X_dim
#6 : \l__enumext_itemindent_X_dim
#7 : \l__enumext_leftmargin_tmp_X_bool

And returns the *"adjusted"* values of \leftmargin and \itemindent.

```
\cs_new_protected:Nn \__enumext_calc_hspace:NNNNNNN
  {
    \dim_compare:nNnT {#1} < { \c_zero_dim }
      {
        \msg_warning:nnnV { enumext } { width-negative }{ labelwidth } #1
        \dim_set:Nn #1 { \dim_abs:n {#1} }
      }
    \dim_compare:nNnT {#2} < { \c_zero_dim }
      {
        \msg_warning:nnnV { enumext } { width-negative }{ labelsep }  #2
        \dim_set:Nn #2 { \dim_abs:n {#2} }
      }
```

If no value has been passed to the labelwidth and labelsep keys, the default values are set for \l__enumext_leftmargin_tmp_X_dim.

```
    \bool_if:NF #7 { \dim_set:Nn #4 { #1 + #2} }
```

The cases are now analyzed and the values for \leftmargin and \itemindent are set.

```
    \dim_compare:nNnTF {#4} < { \c_zero_dim }
      {
        \dim_set:Nn #6 { #1 + #2 - #4}
        \dim_set:Nn #5 { #1 + #2 + #3 - #6 }
      }
      {
        \dim_compare:nNnT {#4} = { #1 + #2 }
          { \dim_set:Nn #6 { \c_zero_dim } }
        \dim_compare:nNnT {#4} < { #1 + #2 }
          { \dim_set:Nn #6 { #1 + #2 - #4} }
        \dim_compare:nNnT {#4} > { #1 + #2 }
          {
            \dim_set:Nn #6 { -#1 - #2 + #4}
            \dim_set:Nn #6 { #6*-1}
          }
        \dim_set:Nn #5 { #1 + #2 + #3 - #6 }
      }
  }
\cs_generate_variant:Nn \__enumext_calc_hspace:NNNNNNN { ccccccc }
```

(*End of definition for* __enumext_calc_hspace:NNNNNNN.)

13.42.5 Setting second argument of the lists

__enumext_unnumbered_list:n

When *tagged* PDF is active the LaTeX kernel declares a list as *ordered* if \@nmbrlist is true, which \usecounter always sets, even if the label key has no counter, for example label={} or label={⟨\textbullet⟩}. The function __enumext_unnumbered_list:n takes the level and sets \@nmbrlist to false if the ⟨*label*⟩ of that level does not use the counter of the level, so the list is declared as *unordered*. The environments restore \@nmbrlist right after opening the list, since the \item command needs it to step the counter.

```
\cs_new_protected:Nn \__enumext_unnumbered_list:n
```

```
    {
      \str_if_in:vnF
        { l__enumext_label_ #1 _tl } { enumX #1 }
        { \legacy_if_set_false:n { @nmbrlist } }
    }
```

(*End of definition for* `\__enumext_unnumbered_list:n`.)

`\__enumext_list_arg_two_i:`
`\__enumext_list_arg_two_ii:`
`\__enumext_list_arg_two_iii:`
`\__enumext_list_arg_two_iv:`
`\__enumext_list_arg_two_v:`

`\leftmargini`, `\leftmarginii`, `\leftmarginiii` and `\leftmarginiv` are "not set"; in this case, the parameters for vertical and horizontal list spacing per level are set directly.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \cs_new_protected:cpn { __enumext_list_arg_two_ #1 : }
      {
        \__enumext_calc_hspace:ccccccc
          { l__enumext_labelwidth_ #1 _dim } { l__enumext_labelsep_ #1 _dim }
          { l__enumext_listoffset_ #1 _dim } { l__enumext_leftmargin_tmp_ #1 _dim }
          { l__enumext_leftmargin_ #1 _dim } { l__enumext_itemindent_ #1 _dim }
          { l__enumext_leftmargin_tmp_ #1 _bool }
        \clist_map_inline:nn
          { labelsep, labelwidth, itemindent, leftmargin, rightmargin,
            listparindent }
          { \dim_set_eq:cc {####1} { l__enumext_####1 _ #1 _dim } }
        \clist_map_inline:nn { topsep, parsep, partopsep, itemsep }
          { \skip_set_eq:cc {####1} { l__enumext_####1 _ #1 _skip } }
        \clist_map_inline:nn { beginparpenalty, itempenalty, endparpenalty }
          { \int_set_eq:cc {@####1} { l__enumext_####1 _ #1 _int } }
        \usecounter { enumX #1 }
        \setcounter { enumX #1 }
          { \int_eval:n { \int_use:c { l__enumext_start_ #1 _int } - 1 } }
        \__enumext_unnumbered_list:n {#1}
        \str_if_eq:nnTF {#1} { v }
          {
            \__enumext_keyans_redefine_item:
            \__enumext_keyans_make_label:
            \__enumext_keyans_ref:
            \__enumext_keyans_fake_item_indent:
            \bool_if:cT { l__enumext_show_length_ #1 _bool }
              {
                \msg_term:nnnn { enumext } { list-lengths-not-nested } { v }
                  { keyans }
              }
          }
          {
            \__enumext_redefine_item:
            \__enumext_make_label:
            \__enumext_standard_ref:
            \__enumext_fake_item_indent:
            \bool_if:cT { l__enumext_show_length_ #1 _bool }
              {
                \msg_term:nnne { enumext } { list-lengths } {#1}
                  { \int_use:N \l__enumext_level_int }
              }
          }
      }
  }
\clist_map_inline:nn { i, ii, iii, iv, v } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\__enumext_list_arg_two_i:` *and others.*)

`\__enumext_list_arg_two_vii:`
`\__enumext_list_arg_two_viii:`

For the horizontal environments `enumext*` and `keyans*` the implementation is similar, but, the value of `\partopsep` is always `0pt`. At this point the `parsep` key is modified to make it take the value of the `itemsep` key and later, in the environment definition, `\parindent` is modified to make it set the value of `listparindent` and `parsep` to set the value of `\parskip` locally.

For compatibility with *tagged* PDF and LaTeX release 2026-06-01, `\setcounter` is moved to `\begin{list}{⟨arg one⟩}{⟨arg two⟩}\setcounter` in the definition of the environments `enumext*` and `keyans*` (§13.48, §13.49). This resolves the nesting problem reported by Tim Prescott (`@teepeemm`) in enumext* nested in enumext starts at 2 with DocumentMetadata this was caused by the `latex-lab-block`[15] update in this release.

```
\cs_set_protected:Nn \__enumext_tmp:n
```

```
  {
    \cs_new_protected:cpn { __enumext_list_arg_two_ #1 : }
      {
        \bool_set_true:c { l__enumext_leftmargin_tmp_ #1 _bool }
        \dim_zero:c { l__enumext_leftmargin_tmp_ #1 _dim }
        \__enumext_calc_hspace:ccccccc
          { l__enumext_labelwidth_ #1 _dim } { l__enumext_labelsep_ #1 _dim }
          { l__enumext_listoffset_ #1 _dim } { l__enumext_leftmargin_tmp_ #1 _dim }
          { l__enumext_leftmargin_ #1 _dim } { l__enumext_itemindent_ #1 _dim }
          { l__enumext_leftmargin_tmp_ #1 _bool }
        \clist_map_inline:nn
          { labelsep, labelwidth, itemindent, leftmargin, rightmargin,
            listparindent }
          { \dim_set_eq:cc {####1} { l__enumext_####1 _ #1 _dim } }
        \clist_map_inline:nn { topsep, parsep, partopsep, itemsep }
          { \skip_set_eq:cc {####1} { l__enumext_####1 _ #1 _skip } }
        \clist_map_inline:nn { beginparpenalty, itempenalty, endparpenalty }
          { \int_set_eq:cc {@####1} { l__enumext_####1 _ #1 _int } }
        \skip_set_eq:Nc \parsep  { l__enumext_itemsep_ #1 _skip }
        \skip_zero:N \partopsep
        \usecounter { enumX #1 }
        % \setcounter { enumX #1 }
        %   { \int_eval:n { \int_use:c { l__enumext_start_ #1 _int } - 1 } }
        \__enumext_starred_ref:
        \str_if_eq:nnTF {#1} { vii }
          {
            \__enumext_fake_item_indent_vii:
            \bool_if:cT { l__enumext_show_length_vii_bool }
              { \msg_term:nnnn { enumext } { list-lengths-not-nested } { vii }
                { enumext* } }
          }
          {
            \__enumext_fake_item_indent_viii:
            \bool_if:cT { l__enumext_show_length_ #1 _bool }
              { \msg_term:nnnn { enumext } { list-lengths-not-nested } {#1}
                { keyans* } }
          }
      }
  }
\clist_map_inline:nn { vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\__enumext_list_arg_two_vii:` *and* `\__enumext_list_arg_two_viii:`.)

13.43 The environment `enumext`

13.43.1 Definition of variables for `enumext`

`\l__enumext_store_upper_level_X_bool` Internal variables used by the *"storing structure"* of the `enumext` environment when it is nested.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \bool_new:c { l__enumext_store_upper_level_ #1 _bool }
  }
\clist_map_inline:nn { i, ii, iii, iv, vii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_store_upper_level_X_bool`.)

13.43.2 Definition of error messages for `enumext`

`list-too-deep` Message for the nesting depth of the environment `enumext`.

```
\msg_new:nnnn { enumext } { list-too-deep }
  {
    Too~deep~nesting~for~'enumext'~\msg_line_context:.
  }
  {
    The~maximum~level~of~nesting~is~4.
  }
```

(*End of definition for* `list-too-deep`.)

13.43.3 Internal functions for enumext

__enumext_safe_exec:

The __enumext_safe_exec: function first calls the function __enumext_is_not_nested:, which sets \g__enumext_standard_bool to true if it is NOT nested within enumext*. Then it calls the function __enumext_internal_mini_page: to create the environment __enumext_mini_page, increments \l__enumext_level_int to restrict nesting of the environment and sets \l__enumext_standard_bool to true. Finally it calls the function __enumext_is_on_first_level:, and only if the environment is NOT nested and is at the *"first level"* it sets \l__enumext_standard_first_bool to true.

```
\cs_new_protected:Nn \__enumext_safe_exec:
  {
    \__enumext_is_not_nested:
    \__enumext_internal_mini_page:
    \int_incr:N \l__enumext_level_int
    \int_compare:nNnT { \l__enumext_level_int } > { 4 }
      { \msg_fatal:nn { enumext } { list-too-deep } }
    \bool_set_true:N \l__enumext_standard_bool
    \bool_set_false:N \l__enumext_starred_bool
    \__enumext_is_on_first_level:
  }
```

(*End of definition for* __enumext_safe_exec:.)

__enumext_parse_keys:n

The __enumext_parse_keys:n function first clears the variable \l__enumext_series_name_str used by the key series and then checks if it is at the *"first level"*; if so, it processes the ⟨*keys*⟩ and then executes the function __enumext_parse_series:n used by the key series and calls the function __enumext_nested_base_line_fix: used by the key base-fix; otherwise it passes the ⟨*keys*⟩ to the inner levels of the environment, then executes the function __enumext_store_active_keys:n and reprocesses the ⟨*keys*⟩ to pass them to the *sequence* if the key save-key is not active.

```
\cs_new_protected:Nn \__enumext_parse_keys:n
  {
    \tl_if_novalue:nF {#1}
      {
        \str_clear:N \l__enumext_series_name_str
        \int_compare:nNnTF { \l__enumext_level_int } = { 1 }
          {
            \keys_set:nn { enumext / level-1 } {#1}
            \bool_if:NF \l__enumext_print_keyans_cmd_bool
              {
                \__enumext_parse_series:n {#1}
              }
            \__enumext_nested_base_line_fix:
          }
          {
            \keys_set:en
              { enumext / level-\int_use:N \l__enumext_level_int } {#1}
            \bool_if:NF \l__enumext_print_keyans_cmd_bool
              {
                \__enumext_parse_series:n {#1}
              }
          }
        \__enumext_store_active_keys:n {#1}
      }
  }
```

(*End of definition for* __enumext_parse_keys:n.)

__enumext_start_store_level:

The __enumext_start_store_level: function activates the *"storing structure"* mechanism in the *sequence* for the command \anskey and the environment anskey*.

```
\cs_new_protected:Nn \__enumext_start_store_level:
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_store_active_bool }
        { \bool_not_p:n { \l__enumext_keyans_env_bool } }
        { \bool_if_p:N \g__enumext_standard_bool }
      }
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 1 }
          {
```

```
            \bool_set_true:c { l__enumext_store_upper_level_ \__enumext_level: _bool }
            \__enumext_store_level_open:
          }
      }
```

If `enumext` are nested in `enumext*` add `\__enumext_store_level_open:` to preserve the *"storing structure"*.

```
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_store_active_bool }
        { \bool_not_p:n { \l__enumext_keyans_env_bool } }
        { \int_compare_p:nNn { \l__enumext_level_h_int } = { 1 } }
      }
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 0 }
          {
            \bool_set_true:c { l__enumext_store_upper_level_ \__enumext_level: _bool }
            \__enumext_store_level_open:
          }
      }
  }
```

(*End of definition for* `\__enumext_start_store_level:`.)

`\__enumext_stop_store_level:` The `\__enumext_stop_store_level:` function stops the *"storing structure"* mechanism in the *sequence* for the command `\anskey` and the environment `anskey*`.

```
\cs_new_protected:Nn \__enumext_stop_store_level:
  {
    \bool_if:cT { l__enumext_store_upper_level_ \__enumext_level: _bool }
      {
        \__enumext_store_level_close:
      }
  }
```

(*End of definition for* `\__enumext_stop_store_level:`.)

`\__enumext_multicols_start:` The function `\__enumext_multicols_start:` will start the `multicols` environment according to the value passed by the `columns` key, then set the default value for `\columnsep` when `columns-sep=0pt` and set the value of `\multicolsep` equal to zero and leave `\columnseprule` equal to zero for inner levels.

```
\cs_new_protected:Nn \__enumext_multicols_start:
  {
    \int_compare:nNnT
      { \int_use:c { l__enumext_columns_ \__enumext_level: _int } } > { 1 }
      {
        \dim_compare:nNnT
          { \dim_use:c { l__enumext_columns_sep_ \__enumext_level: _dim } }
          = { \c_zero_dim }
          {
            \dim_set:cn { l__enumext_columns_sep_ \__enumext_level: _dim }
              {
                ( \dim_use:c { l__enumext_labelwidth_ \__enumext_level: _dim }
                  + \dim_use:c { l__enumext_labelsep_ \__enumext_level: _dim }
                ) / \int_use:c { l__enumext_columns_ \__enumext_level: _int }
                - \dim_use:c { l__enumext_listoffset_ \__enumext_level: _dim }
              }
          }
        \dim_set_eq:Nc \columnsep { l__enumext_columns_sep_ \__enumext_level: _dim }
        \int_compare:nNnT { \l__enumext_level_int } > { 1 }
          {
            \dim_zero:N \columnseprule
          }
```

The *vertical spacing* settings for the `multicols` environment are calculated using the function `\__enumext_multi_addvspace:`, the *"vertical adjust spacing"* is applied, and then the `multicols` environment is started.

```
        \bool_if:cF { l__enumext_minipage_active_ \__enumext_level: _bool }
          {
            \skip_zero:N \multicolsep
            \__enumext_multi_addvspace:
          }
```

```
4441          \raggedcolumns
4442          \begin{multicols}{ \int_use:c { l__enumext_columns_ \__enumext_level: _int } }
4443        }
4444    }
```

(*End of definition for* `\__enumext_multicols_start:`.)

`\__enumext_multicols_stop:`

The function `\__enumext_multicols_stop:` will stop the `multicols` environment and apply the *"vertical adjust"* spacing. When the `mini-env` key is active the space is not added here: it is stored with `\__enumext_mini_capture_multicols:` to be applied by `\__enumext_mini_apply_end:` after the environment on the *"right side"*. For compatibility with *tagged* PDF, the closing of the `list` environment is executed here along with `\__enumext_stop_store_level:`.

```
4445 \cs_new_protected:Nn \__enumext_multicols_stop:
4446   {
4447     \int_compare:nNnTF
4448       { \int_use:c { l__enumext_columns_ \__enumext_level: _int } } > { 1 }
4449       {
4450         \__enumext_stop_list:
4451         \__enumext_stop_store_level:
4452         \end{multicols}
4453         \__enumext_unskip_unkern:
4454         \__enumext_unskip_unkern:
4455         \par
4456         \bool_if:cTF { l__enumext_minipage_active_ \__enumext_level: _bool }
4457           {
4458             \__enumext_mini_capture_multicols:
4459           }
4460           {
4461             \addvspace
4462               { \skip_use:c { l__enumext_multicols_below_ \__enumext_level: _skip } }
4463           }
4464       }
4465       {
4466         \__enumext_stop_list:
4467         \__enumext_stop_store_level:
4468       }
4469   }
```

(*End of definition for* `\__enumext_multicols_stop:`.)

`\__enumext_before_list:`

The function `\__enumext_before_list:` first calls the function `\__enumext_vspace_above:` used by the keys `above` and `above*`, then calls the function `\__enumext_before_args_exec:` used by the key `before*` and finally execute the function `\__enumext_check_ans_active:` for the check answer mechanism.

```
4470 \cs_new_protected:Nn \__enumext_before_list:
4471   {
4472     \__enumext_vspace_above:
4473     \__enumext_before_args_exec:
4474     \__enumext_check_ans_active:
```

When the `mini-env` key is active it will set the value of the `\l__enumext_minipage_right_X_dim` to be the *width* of the `\__enumext_mini_page` environment on the *"right side"*, using this value together with the value of the `\l__enumext_minipage_hsep_X_dim` set by the `mini-sep` key, the value of `\l__enumext_minipage_left_X_dim` will be set, which will be the *width* of `\__enumext_mini_page` environment on the *"left side"*, always having a current `\linewidth` as *maximum width* between them.

```
4475     \dim_compare:nNnT
4476       { \dim_use:c { l__enumext_minipage_right_ \__enumext_level: _dim } }
4477       > { \c_zero_dim }
4478       {
4479         \dim_set:cn { l__enumext_minipage_left_ \__enumext_level: _dim }
4480           {
4481             \linewidth
4482             - \dim_use:c { l__enumext_minipage_right_ \__enumext_level: _dim }
4483             - \dim_use:c { l__enumext_minipage_hsep_ \__enumext_level: _dim }
4484           }
```

The boolean variable `\l__enumext_minipage_active_X_bool` will be activated and the integer variable `\g__enumext_minipage_stat_int` used by the `\miniright` command will be incremented, then the function `\__enumext_minipage_add_space:` is called and the `\__enumext_mini_page` environment on the *"left side"* will be initialized followed by the *"vertical spacing"* applied to preserve the *"baseline"* between the

left and *right* side environments. After these actions, the function __enumext_multicols_start: is called to handle the multicols environment.

```
      \bool_set_true:c { l__enumext_minipage_active_ \__enumext_level: _bool }
      \int_gincr:N \g__enumext_minipage_stat_int
      \__enumext_minipage_add_space:
      \noindent
      \__enumext_mini_page
        { \dim_use:c { l__enumext_minipage_left_ \__enumext_level: _dim } }
    }
  \__enumext_multicols_start:
}
```

(*End of definition for* __enumext_before_list:.)

__enumext_second_part: First of all, the function __enumext_second_part: will check the state of the boolean variable \l__enumext_minipage_active_X_bool. If it is true, a small test is executed to check if \miniright was omitted (the __enumext_mini_page environment has not been closed). Then it closes __enumext_mini_page and adds the stored *adjusted vertical space* using __enumext_mini_apply_end:. Otherwise it closes the multicols environment.

```
\cs_new_protected:Nn \__enumext_second_part:
  {
    \bool_if:cTF { l__enumext_minipage_active_ \__enumext_level: _bool }
      {
        \int_compare:nNnT { \g__enumext_minipage_stat_int } = { 1 }
          {
            \msg_warning:nn { enumext } { missing-miniright }
            \miniright
          }
        \int_gzero:N \g__enumext_minipage_stat_int
        \__enumext_unskip_unkern: % remove topsep + [partopsep]
        \end__enumext_mini_page
        \__enumext_mini_apply_end:
      }
      {
        \__enumext_multicols_stop:
      }
```

Now the function __enumext_after_stop_list:, used by the key after, is executed. After that come the function __enumext_check_ans_key_hook:, used by the key check-ans, and the function __enumext_vspace_below:, used by the keys below and below*. Finally it sets \l__enumext_standard_bool to false and calls the function __enumext_standard_save_counter:, used by the series, resume and resume* keys.

```
    \__enumext_after_stop_list:
    \__enumext_check_ans_key_hook:
    \__enumext_vspace_below:
    \bool_set_false:N \l__enumext_standard_bool
    \bool_if:NF \l__enumext_print_keyans_cmd_bool
      {
        \__enumext_standard_save_counter:
      }
  }
```

(*End of definition for* __enumext_second_part:.)

__enumext_set_item_width: The function __enumext_set_item_width: will set the value of \itemwidth taking into account the value established by the list-offset key for each level of the environment.

```
\cs_new_protected:Nn \__enumext_set_item_width:
  {
    \dim_set:Nn \itemwidth { \linewidth }
    \dim_compare:nT
      {
        \dim_use:c { l__enumext_listoffset_ \__enumext_level: _dim } != \c_zero_dim
      }
      {
        \dim_sub:Nn \itemwidth
          {
            \dim_use:c { l__enumext_listoffset_ \__enumext_level: _dim }
          }
      }
  }
```

(*End of definition for* `\__enumext_set_item_width:`.)

enumext Now create the `enumext` environment based on `list` environment by levels. It accepts an optional `[`⟨*key* = *val*⟩`]` argument in '`#1`'. It first checks where the environment is running (§13.43.3) and processes the ⟨*keys*⟩. Then it applies the vertical space and the code of the keys `above` and `before*`, activates the *"storing structure"* and opens the list with the label of the current level. Finally it sets `\itemwidth` (§13.43.3) and executes the code set by the key `first`.

```
\NewDocumentEnvironment{enumext}{ O{} }
  {
    \__enumext_safe_exec:
    \__enumext_parse_keys:n {#1}
    \__enumext_before_list:
    \__enumext_start_store_level:
    \__enumext_start_list:nn
      { \tl_use:c { l__enumext_label_ \__enumext_level: _tl } }
      {
        \use:c { __enumext_list_arg_two_ \__enumext_level: : }
        \__enumext_before_keys_exec:
      }
    \legacy_if_set_true:n { @nmbrlist }
    \__enumext_set_item_width:
    \__enumext_after_args_exec:
  }
  {
    \__enumext_second_part:
  }
```

(*End of definition for* `enumext`. *This function is documented on page* 5.)

Since the `check-ans` check must not be executed by levels but on the complete list, it is taken out of the `enumext` environment using the *"hook"* function `\__enumext_after_env:nn`.

```
\__enumext_after_env:nn {enumext}
  {
    \__enumext_execute_after_env:
  }
```

13.44 The environment keyans

The environment `keyans` also based on lists. The main differences with the `enumext` environment are the *nesting* and the way the *answers* (choice) will be stored and checked, this environment is intended exclusively for *"multiple choice questions"*.

13.44.1 Definition of error messages for keyans

keyans-nested Message used by `keyans` environment.

```
\msg_new:nnnn { enumext } { keyans-nested }
  {
    The~environment~'keyans'~can't~be~nested~\msg_line_context:.
  }
  {
    Close~the~first~'keyans'~environment~before~starting~
    another~one.
  }
```

(*End of definition for* `keyans-nested`.)

13.44.2 Internal functions for keyans

__enumext_keyans_safe_exec: The `keyans` environment will only be available if the `save-ans` key is active and can only be used at the *"first level"* within the `enumext` environment. The environment must not be nested, so a maximum is set at this point. If the conditions are not met, an error message is returned.

```
\cs_new_protected:Nn \__enumext_keyans_safe_exec:
  {
    \bool_lazy_or:nnF { \l__enumext_store_active_bool } { \__enumext_in_keyans_p: }
      {
        \msg_error:nnnn { enumext } { wrong-place }{ keyans }{ save-ans }
      }
    \int_incr:N \l__enumext_keyans_level_int
    \bool_set_true:N \l__enumext_keyans_env_bool
```

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```
    \__enumext_keyans_name_and_start:
    % Set false for interfering with enumext nested in keyans
    % (yes, its possible and crayze)
    \bool_set_false:N \l__enumext_store_active_bool
    \int_compare:nNnT { \l__enumext_keyans_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { keyans-nested }
      }
    \int_compare:nNnT { \l__enumext_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { keyans-wrong-level }
      }
  }
```

(*End of definition for* `\__enumext_keyans_safe_exec:`.)

`\__enumext_keyans_parse_keys:n` Parse [⟨*key* = *val*⟩] for `keyans` environment.

```
\cs_new_protected:Nn \__enumext_keyans_parse_keys:n
  {
    \keys_set:nn { enumext / keyans } {#1}
  }
```

(*End of definition for* `\__enumext_keyans_parse_keys:n`.)

`\__enumext_before_list_v:` `\__enumext_keyans_multicols_start:` `\__enumext_keyans_multicols_stop:` `\__enumext_second_part_v:` Same implementation as the one used in the `enumext` environment.

```
\cs_new_protected:Nn \__enumext_before_list_v:
  {
    \__enumext_vspace_above_v:
    \__enumext_before_args_exec_v:
    \dim_compare:nNnT { \l__enumext_minipage_right_v_dim } > { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_minipage_left_v_dim
          {
            \linewidth
            - \l__enumext_minipage_right_v_dim
            - \l__enumext_minipage_hsep_v_dim
          }
        \bool_set_true:N \l__enumext_minipage_active_v_bool
        \int_gincr:N \g__enumext_minipage_stat_int
        \__enumext_keyans_minipage_add_space:
        \__enumext_mini_page{ \l__enumext_minipage_left_v_dim }
      }
    \__enumext_keyans_multicols_start:
  }
\cs_new_protected:Nn \__enumext_keyans_multicols_start:
  {
    \int_compare:nNnT { \l__enumext_columns_v_int } > { 1 }
      {
        \dim_compare:nNnT { \l__enumext_columns_sep_v_dim } = { \c_zero_dim }
          {
            \dim_set:Nn \l__enumext_columns_sep_v_dim
              {
                (
                  \l__enumext_labelwidth_v_dim + \l__enumext_labelsep_v_dim
                ) / \l__enumext_columns_v_int
                - \l__enumext_listoffset_v_dim
              }
          }
        \dim_set_eq:NN \columnsep \l__enumext_columns_sep_v_dim
        \dim_zero:N \columnseprule % no rule here
        \bool_if:NF \l__enumext_minipage_active_v_bool
          {
            \skip_zero:N \multicolsep
            \__enumext_keyans_multi_addvspace:
          }
        \raggedcolumns
        \begin{multicols}{ \l__enumext_columns_v_int }
      }
  }
\cs_new_protected:Nn \__enumext_keyans_multicols_stop:
  {
```

```
    \int_compare:nNnTF { \l__enumext_columns_v_int } > { 1 }
      {
        \__enumext_stop_list:
        \end{multicols}
        \__enumext_unskip_unkern:
        \__enumext_unskip_unkern:
        \par
        \bool_if:NTF \l__enumext_minipage_active_v_bool
          {
            \__enumext_mini_capture_multicols:
          }
          {
            \addvspace{ \l__enumext_multicols_below_v_skip }
          }
      }
      {
        \__enumext_stop_list:
      }
  }
\cs_new_protected:Nn \__enumext_second_part_v:
  {
    \bool_if:NTF \l__enumext_minipage_active_v_bool
      {
        \int_compare:nNnT { \g__enumext_minipage_stat_int } = { 1 }
          {
            \msg_warning:nn { enumext } { missing-miniright }
            \miniright
          }
        \int_gzero:N \g__enumext_minipage_stat_int
        \__enumext_unskip_unkern: % remove \topsep + [\partopsep]
        \end__enumext_mini_page
        \__enumext_mini_apply_end:
      }
      {
        \__enumext_keyans_multicols_stop:
      }
    \bool_set_false:N \l__enumext_keyans_env_bool
    \__enumext_after_stop_list_v:
    \__enumext_vspace_below_v:
  }
```

(*End of definition for* `\__enumext_before_list_v:` *and others.*)

`\__enumext_keyans_set_item_width:` The function `\__enumext_keyans_set_item_width:` will set the value of `\itemwidth` taking into account the value established by the `list-offset` key.

```
\cs_new_protected:Nn \__enumext_keyans_set_item_width:
  {
    \dim_set:Nn \itemwidth { \linewidth }
    \dim_compare:nT
      {
        \l__enumext_listoffset_v_dim != \c_zero_dim
      }
      {
        \dim_sub:Nn \itemwidth { \l__enumext_listoffset_v_dim }
      }
  }
```

(*End of definition for* `\__enumext_keyans_set_item_width:`.)

`keyans` Defines the environment `keyans`, also based on lists. It accepts an optional `[`⟨*key* = *val*⟩`]` argument in '`#1`'. It first checks that the environment is available and where it is running, and processes the ⟨*keys*⟩. Then it opens the list, sets `\itemwidth` (§13.44.2) and executes the code set by the key `first`. In the second part it checks the use of `\item*` and finishes the environment.

```
\NewDocumentEnvironment{keyans}{ O{} }
  {
    \__enumext_keyans_safe_exec:
    \__enumext_keyans_parse_keys:n {#1}
    \__enumext_before_list_v:
    \__enumext_start_list:nn
      { \tl_use:N \l__enumext_label_v_tl }
```

```
      {
        \__enumext_list_arg_two_v:
        \__enumext_before_keys_exec_v:
      }
    \legacy_if_set_true:n { @nmbrlist }
    \__enumext_keyans_set_item_width:
    \__enumext_after_args_exec_v:
  }
  {
    \__enumext_check_starred_cmd:n { item }
    \__enumext_second_part_v:
  }
```

(*End of definition for* keyans. *This function is documented on page 18.*)

13.45 Tagging PDF support for non-standard list environments

The LaTeX release 2022-06-01 brings automatic support for *tagged* PDF in several aspects, including the standard *list environments* and the list environment. Unfortunately non-standard *list environments* like keyanspic or the horizontal list environments enumext* and keyans* are not structured in a nice way, i.e. the visual result in the PDF file is the expected one, but the underlying structure is not correct. In simple terms, for *tagged* PDF a list environment is a list environment, no matter what it looks like in the PDF file.

To maintain a correct list structure when \DocumentMetadata is active, it is necessary to do some things manually using tagpdf[18] and ltsockets[19]. This implementation is an adaptation of the answer given by the author of this package thanks to Ulrike Fischer's comments in How can I modify my \item redefinition to be compatible with tagging-pdf.

13.45.1 Socket for tagging support in enumext* and keyans*

start-list-tags
stop-start-tags
stop-list-tags
stop-list-tags-par
__enumext_start_list_tag:n
__enumext_stop_start_list_tag:
__enumext_stop_list_tag:n
__enumext_stop_item_break_tag:n
__enumext_stop_start_break_tag:
stop-start-tags-break
stop-list-tags-break

First, the necessary sockets and their behavior are defined for enumext* and keyans*.

```
\socket_new:nn {tagsupport/__enumext/starred}{ 1 }
\socket_new_plug:nnn {tagsupport/__enumext/starred} {start-list-tags}
  {
    \tag_resume:n {#1}
      \tag_struct_begin:n {tag=LI}
        \tag_struct_begin:n {tag=Lbl}
          \tag_mc_begin:n {tag=Lbl}
  }
\socket_new_plug:nnn {tagsupport/__enumext/starred} {stop-start-tags}
  {
          \tag_mc_end:
        \tag_struct_end:n {tag=Lbl}
        \tag_struct_begin:n {tag=LBody}
          % {tag=text-unit} now "semantic-para"
          % (https://github.com/latex3/latex2e/commit/83f054afc042e82a664085b6f2fd7c8d61705fb9)
          \tag_struct_begin:n {tag=semantic-para}
            % {tag=text} now "text-block"
            \tag_struct_begin:n {tag=text-block}
  }
\socket_new_plug:nnn {tagsupport/__enumext/starred} {stop-list-tags}
  {
            \tag_struct_end:n {tag=text-block}
          \tag_struct_end:n {tag=semantic-para} % {tag=text-unit}
        \tag_struct_end:n {tag=LBody}
      \tag_struct_end:n {tag=LI}
    \tag_suspend:n {#1}
  }
\socket_new_plug:nnn {tagsupport/__enumext/starred} {stop-list-tags-par}
  {
        \tag_struct_end:n {tag=LBody}
      \tag_struct_end:n {tag=LI}
    \tag_suspend:n {#1}
  }
\socket_new_plug:nnn {tagsupport/__enumext/starred} {stop-start-tags-break}
  {
          \tag_mc_end:
        \tag_struct_end:n {tag=Lbl}
        \tag_struct_begin:n {tag=LBody}
          \tag_socket_use:nn {para/semantic/begin} { }
          \tag_socket_use:nn {para/textblock/begin} { }
  }
```

```
\socket_new_plug:nnn {tagsupport/__enumext/starred} {stop-list-tags-break}
  {
          \tag_socket_use:n {para/textblock/end}
          \tag_socket_use:nn {para/semantic/end} { }
        \tag_struct_end:n {tag=LBody}
      \tag_struct_end:n {tag=LI}
    \tag_suspend:n {#1}
  }
```

And now they are wrapped so that they are only active when `\DocumentMetadata` is present.

```
\cs_new_protected_nopar:Nn \__enumext_start_list_tag:n
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/starred} {start-list-tags}
        \socket_use:nn {tagsupport/__enumext/starred} {#1}
      }
  }
\cs_new_protected_nopar:Nn \__enumext_stop_start_list_tag:
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/starred} {stop-start-tags}
        \socket_use:nn {tagsupport/__enumext/starred} { }
      }
  }
\cs_new_protected_nopar:Nn \__enumext_stop_start_break_tag:
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/starred} {stop-start-tags-break}
        \socket_use:nn {tagsupport/__enumext/starred} { }
      }
  }
\cs_new_protected_nopar:Nn \__enumext_stop_list_tag:n
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/starred} {stop-list-tags}
        \socket_use:nn {tagsupport/__enumext/starred} {#1}
      }
  }
```

The items of `item-break` have no `minipage`, so the paragraphs of the ⟨*content*⟩ are tagged by the *paragraph hooks*. The first paragraph of the item is opened while the tagging is still suspended, because the label is placed before the structures of the ⟨*content*⟩ are started, so its *begin* hook is never executed. For this reason, the plug `stop-start-tags-break` (used by `\__enumext_stop_start_break_tag:`) opens the structures of that paragraph using the sockets `para/semantic/begin` and `para/textblock/begin` of the LaTeX kernel. These sockets also take care of the counters of the *paragraph hooks*, the names of the tags and the class of the `Layout` attribute `TextAlign`. If the last paragraph of the item has already been ended by a `\par`, coming from an empty line before the next `\item` or before `\end` or from a `\par` inside a group, the hook has closed the `text-block` and `semantic-para` structures and the marked content, and we are in *vertical mode*. Then only `LBody` and `LI` remain to be closed, using the plug `stop-list-tags-par`. When the item ends with a standard list (`itemize`, for example) we are also in *vertical mode*, but the `semantic-para` that contains the list is still open, because the kernel closes it with the `\par` that ends the paragraph *continued* after the list. For this reason a `\par` is executed first in vertical mode: it closes that structure, and if there is nothing pending it does nothing. Otherwise the paragraph is still open and the plug `stop-list-tags-break` closes it with the sockets `para/textblock/end` and `para/semantic/end`, before the `\par` that ends the item. That `\par` runs with the tagging suspended and is not counted.

```
\cs_new_protected_nopar:Nn \__enumext_stop_item_break_tag:n
  {
    \IfDocumentMetadataT
      {
        \mode_if_vertical:TF
          {
            \par
            \socket_assign_plug:nn {tagsupport/__enumext/starred} {stop-list-tags-par}
          }
          {
```

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```
            \socket_assign_plug:nn
              {tagsupport/__enumext/starred} {stop-list-tags-break}
          }
        \socket_use:nn {tagsupport/__enumext/starred} {#1}
      }
  }
```

(*End of definition for* `start-list-tags` *and others.*)

13.45.2 Socket for tagging support in `keyanspic`

start-list-tags
stop-start-tags
stop-list-tags
__enumext_anspic_start_list_tag:
__enumext_anspic_stop_start_list_tag:
__enumext_anspic_stop_list_tag:

First, the necessary `sockets` and their behavior are defined for the `keyanspic` environment.

```
\socket_new:nn {tagsupport/__enumext/keyanspic}{ 0 }
\socket_new_plug:nnn {tagsupport/__enumext/keyanspic} {start-list-tags}
  {
    \tag_resume:n {keyanspic}
      \tag_struct_begin:n {tag=LI}
        \tag_struct_begin:n {tag=Lbl}
          \tag_mc_begin:n {tag=Lbl}
  }
\socket_new_plug:nnn {tagsupport/__enumext/keyanspic} {stop-start-tags}
  {
          \tag_mc_end:
        \tag_struct_end:n {tag=Lbl}
        \tag_struct_begin:n {tag=LBody}
          \tag_struct_begin:n {tag=semantic-para}
            \tag_struct_begin:n {tag=text-block}
              \tag_mc_begin:n {tag=text-block}
  }
\socket_new_plug:nnn {tagsupport/__enumext/keyanspic} {stop-list-tags}
  {
              \tag_mc_end:
            \tag_struct_end:n {tag=text-block}
          \tag_struct_end:n {tag=semantic-para}
        \tag_struct_end:n {tag=LBody}
      \tag_struct_end:n {tag=LI}
    \tag_suspend:n {keyanspic}
  }
```

And now they are wrapped so that they are only active when `\DocumentMetadata` is present.

```
\cs_new_protected_nopar:Nn \__enumext_anspic_start_list_tag:
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/keyanspic} {start-list-tags}
        \socket_use:n {tagsupport/__enumext/keyanspic}
      }
  }
\cs_new_protected_nopar:Nn \__enumext_anspic_stop_start_list_tag:
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/keyanspic} {stop-start-tags}
        \socket_use:n {tagsupport/__enumext/keyanspic}
      }
  }
\cs_new_protected_nopar:Nn \__enumext_anspic_stop_list_tag:
  {
    \IfDocumentMetadataT
      {
        \socket_assign_plug:nn {tagsupport/__enumext/keyanspic} {stop-list-tags}
        \socket_use:n {tagsupport/__enumext/keyanspic}
      }
  }
```

(*End of definition for* `start-list-tags` *and others.*)

13.46 The environment `keyanspic` and `\anspic`

The `keyanspic` environment is a `list` based environment that uses the same configuration for *"spacing"* and ⟨*label*⟩ as the `keyans` environment, but it does not use `\item`. The ⟨*contents*⟩ are passed to the environment

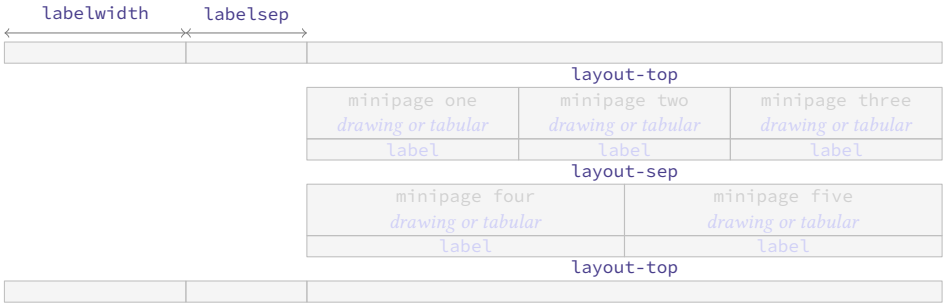

Figure 12: Representation of the keyanspic spacing in enumext.

by means of the \anspic command as replacement for \item command and placed inside minipage environments, with the ⟨*label*⟩ centered *"above"* or *"below"*, adjusting *widths* and *position* according to the options passed to the environment.

In order for the keyanspic environment and the \anspic command to work correctly, some variables must be set and exported in the first part of the environment definition and pass them to \anspic which is executed in the second part of the environment. This implementation is adapted from the answer given by Enrico Gregorio (@egreg) in How to process the body of an environment and divide it by a \macro?.

13.46.1 Definition of variables for keyanspic and \anspic

\l__enumext_anspic_args_seq
\l__enumext_anspic_mini_width_dim
\l__enumext_anspic_above_int
\l__enumext_anspic_below_int
\l__enumext_anspic_label_above_bool
\l__enumext_anspic_mini_pos_str
\l__enumext_anspic_label_box
\l__enumext_anspic_body_box
\l__enumext_anspic_label_ht_dim
\l__enumext_anspic_label_dp_dim
\l__enumext_anspic_label_htdp_dim
\l__enumext_anspic_body_htdp_dim
\l__enumext_anspic_gap_dim
\l__enumext_anspic_label_sep_skip
\l__enumext_anspic_top_skip
\l__enumext_anspic_label_sep_bool
\l__enumext_anspic_top_bool

Internal variables used by keyanspic environment and \anspic command (§13.46.3).

```
\seq_new:N  \l__enumext_anspic_args_seq
\dim_new:N  \l__enumext_anspic_mini_width_dim
\int_new:N  \l__enumext_anspic_above_int
\int_new:N  \l__enumext_anspic_below_int
\bool_new:N \l__enumext_anspic_label_above_bool
\str_new:N  \l__enumext_anspic_mini_pos_str
\box_new:N  \l__enumext_anspic_label_box
\box_new:N  \l__enumext_anspic_body_box
\dim_new:N  \l__enumext_anspic_label_ht_dim
\dim_new:N  \l__enumext_anspic_label_dp_dim
\dim_new:N  \l__enumext_anspic_label_htdp_dim
\dim_new:N  \l__enumext_anspic_body_htdp_dim
\dim_new:N  \l__enumext_anspic_gap_dim
\skip_new:N \l__enumext_anspic_label_sep_skip
\skip_new:N \l__enumext_anspic_top_skip
\bool_new:N \l__enumext_anspic_label_sep_bool
\bool_new:N \l__enumext_anspic_top_bool
```

(*End of definition for* `\l__enumext_anspic_args_seq` *and others.*)

13.46.2 Definition of error messages for keyanspic

keyanspic-nested
keyanspic-wrong-level
keyanspic-item-cmd

Messages used by keyanspic environment.

```
\msg_new:nnnn { enumext } { keyanspic-nested }
  {
    The~environment~'keyanspic'~can't~be~nested~\msg_line_context:.
  }
  {
    Close~the~first~'keyanspic'~environment~before~starting~
    another~one.
  }
\msg_new:nnnn { enumext } { keyanspic-wrong-level }
  {
    Wrong~level~position~for~'keyanspic'~\msg_line_context:.
  }
  {
    The~environment~'keyanspic'~can~only~be~in~the~first~level.
  }
\msg_new:nnnn { enumext } { keyanspic-item-cmd }
  {
    Can't~use~'\token_to_str:N \item'~in~'keyanspic'~\msg_line_context:.
  }
  {
    Remove~'\token_to_str:N \item'~from~the~'keyanspic'~environment.
  }
```

(*End of definition for* `keyanspic-nested`, `keyanspic-wrong-level`, *and* `keyanspic-item-cmd`.)

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13.46.3 The environment keyanspic

label-pos
label-sep
layout-sty
layout-sep
layout-top
mark-ans
mark-pos
mark-sep
save-sep
wrap-opt
wrap-ans*
show-ans
show-pos
unknown

First the keys are defined. The position of the ⟨*label*⟩ centered "above" or "below" is handled by `label-pos`, and its vertical separation from the *drawing or tabular* by the key `label-sep`. The *"layout style"* is handled by the key `layout-sty`, which takes two values separated by comma {⟨*n° upper, n° lower*⟩} and determines the number of `minipage` environments in which all arguments of `\anspic` are printed at the "upper" and "lower" within the environments separated by the value of the key `layout-sep`. The vertical space "top" and "bottom" of the environment is handled by the key `layout-top`.

```
\keys_define:nn { enumext / keyanspic }
  {
    label-pos  .choices:nn =
      { above , below }
      {
        \int_case:nn { \l_keys_choice_int }
          {
            {1}
              {
                \bool_set_true:N \l__enumext_anspic_label_above_bool
                \str_set:Nn \l__enumext_anspic_mini_pos_str { t }
              }
            {2}
              {
                \bool_set_false:N \l__enumext_anspic_label_above_bool
                \str_set:Nn \l__enumext_anspic_mini_pos_str { b }
              }
          }
      },
    label-pos  .initial:n = below,
    label-pos  .value_required:n = true,
    label-pos / unknown .code:n =
      \msg_error:nneee { enumext } { unknown-choice }
        { label-pos } { above,~ below } { \exp_not:n {#1} },
    label-sep  .code:n =
      {
        \skip_set:Nn \l__enumext_anspic_label_sep_skip {#1}
        \bool_set_true:N \l__enumext_anspic_label_sep_bool
      },
    label-sep  .value_required:n = true,
    layout-sty .tl_set:N = \l__enumext_anspic_layout_style_tl,
    layout-sty .value_required:n = true,
    layout-sep .meta:nn = { enumext / keyans } { parsep = {#1} },
    layout-sep .value_required:n = true,
    layout-top .code:n =
      {
        \skip_set:Nn \l__enumext_anspic_top_skip {#1}
        \bool_set_true:N \l__enumext_anspic_top_bool
      },
    layout-top .value_required:n = true,
    mark-ans   .meta:nn = { enumext / keyans } { mark-ans = {#1} },
    mark-ans   .value_required:n = true,
    mark-pos   .meta:nn = { enumext / keyans } { mark-pos = {#1} },
    mark-pos   .value_required:n = true,
    mark-sep   .meta:nn = { enumext / keyans } { mark-sep = {#1} },
    mark-sep   .value_required:n = true,
    save-sep   .meta:nn = { enumext / keyans } { save-sep = {#1} },
    save-sep   .value_required:n = true,
    wrap-opt   .meta:nn = { enumext / keyans } { wrap-opt = {#1} },
    wrap-opt   .value_required:n = true,
    wrap-ans*  .meta:nn = { enumext / keyans } { wrap-ans* = {#1} },
    wrap-ans*  .value_required:n = true,
    show-ans   .meta:nn = { enumext / keyans } { show-ans = {#1} },
    show-ans   .value_required:n = true,
    show-pos   .meta:nn = { enumext / keyans } { show-pos = {#1} },
    show-pos   .value_required:n = true,
    unknown    .code:n =
      {
        \tl_set:Ne \l__enumext_envir_name_tl { keyanspic }
        \__enumext_keyans_unknown_keys:n {#1}
      },
  }
```

(*End of definition for* `label-pos` *and others.*)

`\__enumext_keyans_pic_safe_exec:`
`\__enumext_keyans_pic_parse_keys:n`
`\__enumext_keyans_pic_skip_abs:N`
`\__enumext_keyans_pic_arg_two:`
`\__enumext_anspic_top_glue:`
`\__enumext_anspic_bottom_glue:`

The function `\__enumext_keyans_pic_safe_exec:` check the nested level position inside the `enumext` environment.

```
\cs_new_protected:Nn \__enumext_keyans_pic_safe_exec:
  {
    \int_incr:N \l__enumext_keyans_pic_level_int
    \int_compare:nNnT { \l__enumext_keyans_pic_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { keyanspic-nested }
      }
    \__enumext_keyans_name_and_start:
  }
```

Parse `[`⟨*key* = *val*⟩`]` for `keyanspic` environment.

```
\cs_new_protected:Nn \__enumext_keyans_pic_parse_keys:n
  {
    \tl_if_novalue:nF {#1}
      {
        \keys_set:nn { enumext / keyanspic } {#1}
      }
  }
```

The function `\__enumext_keyans_pic_skip_abs:N` will return a positive value `\parsep` from `keyans` environment.

```
\cs_new_protected:Nn \__enumext_keyans_pic_skip_abs:N
  {
    \dim_compare:nNnT {#1} < { \c_zero_dim }
      {
        \skip_set:Nn #1 { -#1 }
      }
  }
```

The `\__enumext_keyans_pic_arg_two:` function is used in the *second argument* of the `list` environment that defines the `keyanspic` environment, taking the configuration of the *"spaces"* and the keys `label`, `wrap-label` and `parsep` from the `keyans` environment. The first step is to set the boolean variable `\l__enumext_leftmargin_tmp_v_bool` handled by the `list-indent` key to `false`, then copy the definition of the second list argument from the `keyans` environment definition and make sure that `\parsep` does not have a negative value.

```
\cs_new_protected:Nn \__enumext_keyans_pic_arg_two:
  {
    \bool_set_false:N \l__enumext_leftmargin_tmp_v_bool
    \__enumext_list_arg_two_v:
    \__enumext_keyans_pic_skip_abs:N \parsep
```

Now the counter `enumXv` of the `keyans` environment is incremented and the dimensions of the ⟨*label*⟩ are saved in `\l__enumext_anspic_label_ht_dim`, `\l__enumext_anspic_label_dp_dim` and `\l__enumext_anspic_label_htdp_dim`, used by `\anspic`, the counter is restored if the key `label-pos` is set to *above*. If the key `label-sep` is not set, its value is `1pt` for *above* and `5pt` for *below*.

```
    \stepcounter { enumXv }
    \hbox_set:Nn \l__enumext_anspic_label_box { \l__enumext_label_v_tl }
    \dim_set:Nn \l__enumext_anspic_label_ht_dim
      { \box_ht:N \l__enumext_anspic_label_box }
    \dim_set:Nn \l__enumext_anspic_label_dp_dim
      { \box_dp:N \l__enumext_anspic_label_box }
    \dim_set:Nn \l__enumext_anspic_label_htdp_dim
      {
        \l__enumext_anspic_label_ht_dim + \l__enumext_anspic_label_dp_dim
      }
    \bool_if:NT \l__enumext_anspic_label_above_bool
      {
        \addtocounter { enumXv } { -1 }
      }
    \bool_if:NF \l__enumext_anspic_label_sep_bool
      {
        \bool_if:NTF \l__enumext_anspic_label_above_bool
          {
            \skip_set:Nn \l__enumext_anspic_label_sep_skip { 1pt }
```

```
5001            }
5002            {
5003              \skip_set:Nn \l__enumext_anspic_label_sep_skip { 5pt }
5004            }
5005        }
```

Finally the value of `\leftmargin` is *adjusted*, then `\topsep`, `\listparindent`, `\partopsep` and `\itemsep` are set to zero so that the *horizontal* and *vertical* space is not affected. The spaces *"above"* and *"below"* the environment are added by `\__enumext_anspic_top_glue:` and `\__enumext_anspic_bottom_glue:`.

```
5006      \dim_add:Nn \leftmargin
5007        { -\l__enumext_labelwidth_v_dim - \l__enumext_labelsep_v_dim }
5008      \ignorespaces
5009      \skip_zero:N \topsep
5010      \dim_zero:N  \listparindent
5011      \skip_zero:N \partopsep
5012      \skip_zero:N \itemsep
5013    }
```

The function `\__enumext_anspic_top_glue:` adds the *vertical space "above"* the first row. If the key `layout-top` is set, that value is used. Otherwise the value of `\topsep` taken from the `keyans` environment is added, plus the space that TEX would add between the previous line and a line with the height of the ⟨*label*⟩, calculated with `\baselineskip`, `\lineskip` and `\lineskiplimit`, so that the space is the same as *"above"* the first `\item` of `keyans`. Finally `\nointerlineskip` avoids adding more space.

```
5014 \cs_new_protected:Nn \__enumext_anspic_top_glue:
5015   {
5016     \bool_if:NTF \l__enumext_anspic_top_bool
5017       {
5018         \addvspace { \l__enumext_anspic_top_skip }
5019       }
5020       {
5021         \addvspace { \l__enumext_topsep_v_skip }
5022         \dim_compare:nNnF { \prevdepth } < { -999pt }
5023           {
5024             \dim_set:Nn \l__enumext_anspic_gap_dim
5025               {
5026                 \baselineskip - \prevdepth - \l__enumext_anspic_label_ht_dim
5027               }
5028             \dim_compare:nNnTF { \l__enumext_anspic_gap_dim } < { \lineskiplimit }
5029               {
5030                 \skip_vertical:N \lineskip
5031               }
5032               {
5033                 \skip_vertical:n { \l__enumext_anspic_gap_dim }
5034               }
5035           }
5036       }
5037     \nointerlineskip
5038   }
```

The function `\__enumext_anspic_bottom_glue:` adds the *vertical space "below"* the last row. If the key `layout-top` is set, that value is used and `\nointerlineskip` avoids adding more space. Otherwise `\prevdepth` takes the depth of the ⟨*label*⟩ and the value of `\topsep` taken from the `keyans` environment is added, so that the space is the same as *"below"* the last `\item` of `keyans`. It must be executed before closing the `list` environment and `\parskip` is set to zero, otherwise `\endtrivlist` adds it to the space.

```
5039 \cs_new_protected:Nn \__enumext_anspic_bottom_glue:
5040   {
5041     \bool_if:NTF \l__enumext_anspic_top_bool
5042       {
5043         \nointerlineskip
5044         \skip_vertical:N \l__enumext_anspic_top_skip
5045       }
5046       {
5047         \prevdepth \l__enumext_anspic_label_dp_dim
5048         \skip_vertical:N \l__enumext_topsep_v_skip
5049       }
5050     \skip_zero:N \parskip
5051   }
```

(*End of definition for* `\__enumext_keyans_pic_safe_exec:` *and others.*)

keyanspic Defines the environment keyanspic. It accepts an optional [⟨*key* = *val*⟩] argument in '#1' that is processed after checking the nested level. For compatibility with *tagged* PDF the \begin{list} form must be used, along with a lot of conditional code using \IfDocumentMetadataTF. First, the code for automatic *tagged* PDF for list environments is stopped, \item is redefined so that it cannot be used, and the code for automatic *tagged* PDF is stopped for the keyanspic environment. The space *"above"* is added with __enumext_anspic_top_glue: before \item, and \nointerlineskip avoids adding the space between lines for the first row.

```
\NewDocumentEnvironment{keyanspic}{ o }
  {
    \__enumext_keyans_pic_safe_exec:
    \__enumext_keyans_pic_parse_keys:n {#1}
    \begin{list} { } { \__enumext_keyans_pic_arg_two: }
    \IfDocumentMetadataT
      {
        \tag_suspend:n {list}
      }
    \__enumext_anspic_top_glue:
    \item[] \scan_stop:
    \nointerlineskip
    \RenewDocumentCommand \item {}
      {
        \msg_error:nn { enumext } { keyanspic-item-cmd }
      }
    \IfDocumentMetadataT
      {
        \tag_resume:n {keyanspic}
        \tag_socket_use:n { para/off }
        \tag_suspend:n {keyanspic}
      }
  }
```

In the second part of the environment definition, the code for *tagged* PDF is placed manually and the command is executed: \anspic is run using the __enumext_anspic_exec: function. The space *"below"* is added before closing the list environment.

```
  {
    \IfDocumentMetadataT
      {
        \tag_resume:n {keyanspic}
      }
    \__enumext_anspic_exec:
    \IfDocumentMetadataT
      {
        \tag_suspend:n {keyanspic}
      }
    \par
    \__enumext_anspic_bottom_glue:
    \end{list}
    \IfDocumentMetadataT
      {
        \tag_struct_end:n {tag=L}
      }
```

Finally it checks if \anspic* has been used and sets the counter enumXvi to zero.

```
    \__enumext_check_starred_cmd:n { anspic }
    \setcounter { enumXvi } { 0 }
  }
```

(*End of definition for* keyanspic. *This function is documented on page 19.*)

13.46.4 The command \anspic

The \anspic command takes three arguments, the *starred versions* \anspic*[⟨*content*⟩] *store* the current ⟨*label*⟩ next to the *optional argument* [⟨*content*⟩] in the *sequence* and *prop list* defined by save-ans key. The third *mandatory argument* {⟨*drawing or tabular*⟩} is NOT *stored* in the *sequence* or *prop list*.

One of the complications here to make the keyanspic environment compatible with *tagged* PDF is the position of ⟨*label*⟩, the \anspic command processes the arguments in order, where '#1' and '#2' correspond to ⟨*label*⟩ and '#3' to the mandatory argument and puts all this inside a minipage environment. If '#1' and '#2', that is ⟨*label*⟩, is above '#3' there are no problems with *tagged* PDF, but if '#3' comes first the list created with *tagged* PDF will not be correct.

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__enumext_anspic_body_dim:n
__enumext_anspic_label:nn
__enumext_anspic_label_pos:nnn
__enumext_anspic_args:nnn
__enumext_anspic_print:n
__enumext_anspic_print:e
__enumext_anspic_print:V
__enumext_anspic_row:n
__enumext_anspic_exec:

If the key label-pos is set "below", the __enumext_anspic_body_dim:n function will set the value of \l__enumext_anspic_body_htdp_dim equal to the "height plus depth" of the *mandatory argument*.

```
\cs_new_protected:Nn \__enumext_anspic_body_dim:n
  {
    \bool_if:NF \l__enumext_anspic_label_above_bool
      {
        \IfDocumentMetadataT
          {
            \tag_suspend:n {keyanspic}
          }
        \vbox_set:Nn \l__enumext_anspic_body_box {#1}
        \dim_set:Nn \l__enumext_anspic_body_htdp_dim
          {
            \box_ht_plus_dp:N \l__enumext_anspic_body_box
          }
        \IfDocumentMetadataT
          {
            \tag_resume:n {keyanspic}
          }
      }
  }
```

The __enumext_anspic_label:nn function will process inside \makebox the *starred argument* '*' and *optional argument* passed to the command. Here the ⟨*label*⟩ and *optional argument* are stored in *prop list* and *sequence* and the show-ans, show-pos, font, wrap-label, wrap-ans* and wrap-opt keys are executed.

```
\cs_new_protected:Nn \__enumext_anspic_label:nn
  {
    \makebox[ \l__enumext_anspic_mini_width_dim ][ c ]
      {
        \bool_if:nTF {#1}
          {
            \bool_set_true:N \l__enumext_item_wrap_key_bool
            \bool_set_true:N \l__enumext_wrap_label_v_bool
            \__enumext_keyans_save_item_opt:n {#2}
            \__enumext_keyans_addto_prop:n {#2}
            \__enumext_keyans_store_ref:
            \__enumext_keyans_addto_seq:n {#2}
            \int_gincr:N \g__enumext_check_starred_cmd_int
            \__enumext_keyans_show_ans:
            \__enumext_keyans_show_pos:
            \makebox[ \l__enumext_labelwidth_v_dim ][c]
              {
                \tl_use:N \l__enumext_label_font_style_v_tl
                \__enumext_keyans_wrapper_label:n { \l__enumext_label_vi_tl }
              }
            \skip_horizontal:n { \l__enumext_labelsep_v_dim }
            \__enumext_keyans_show_item_opt:
          }
          {
            \bool_set_false:N \l__enumext_item_wrap_key_bool
            \tl_use:N \l__enumext_label_font_style_v_tl
            \__enumext_wrapper_label_v:n { \l__enumext_label_vi_tl }
          }
      }
  }
```

The function __enumext_anspic_label_pos:nnn will be in charge of handling the *"counter"* and the position of the ⟨*label*⟩, set by label-pos key which will have the same configuration as the keyans environment. When the ⟨*label*⟩ goes *"below"* it is placed in a box without *height* and *depth* and lowered the *height plus depth* of the *drawing or tabular*, the value of label-sep and the *height* of the ⟨*label*⟩, so that it ends below the *drawing or tabular*.

```
\cs_new_protected:Nn \__enumext_anspic_label_pos:nnn
  {
    \stepcounter { enumXvi }
    \__enumext_anspic_body_dim:n {#3}
    \bool_if:NTF \l__enumext_anspic_label_above_bool
      {
        \__enumext_anspic_label:nn {#1} {#2}
      }
```

```
      {
        \raisebox
          {
            -\dim_eval:n
              {
                \l__enumext_anspic_body_htdp_dim
                + \l__enumext_anspic_label_sep_skip
                + \l__enumext_anspic_label_ht_dim
              }
          }
          [ 0pt ] [ 0pt ]
          {
            \__enumext_anspic_label:nn {#1} {#2}
          }
      }
  }
%
```

The `\__enumext_anspic_args:nnn` function will be responsible for placing the code compatible with *tagged* PDF and the arguments within the `\l__enumext_anspic_args_seq` sequence which will be processed by the `\__enumext_anspic_print:n` function in the second part of the definition of the `keyanspic` environment. The ⟨*label*⟩ is closed with `\par` and `\nointerlineskip` avoids the space between lines, so the separation is exactly the value of `label-sep`. If the ⟨*label*⟩ goes *"below"*, that separation and the *height plus depth* of the ⟨*label*⟩ are reserved at the end with `\kern`, because the `minipage` environment removes the last glue with `\unskip`.

```
\cs_new_protected:Nn \__enumext_anspic_args:nnn
  {
    \__enumext_anspic_start_list_tag:
    \__enumext_anspic_label_pos:nnn {#1} {#2} {#3}
    \__enumext_anspic_stop_start_list_tag:
    \par
    \nointerlineskip
    \bool_if:NTF \l__enumext_anspic_label_above_bool
      {
        \skip_vertical:N \l__enumext_anspic_label_sep_skip
        #3
      }
      {
        #3
        \par
        \nointerlineskip
        \kern \dim_eval:n
          {
            \l__enumext_anspic_label_sep_skip + \l__enumext_anspic_label_htdp_dim
          }
      }
    \__enumext_anspic_stop_list_tag:
  }
```

The value {⟨*n° upper, n° lower*⟩} passed to the `layout-sty` key is split by comma and is handled directly by the function `\__enumext_anspic_print:n` and passed to the function `\__enumext_anspic_row:n`.

```
\cs_new_protected:Nn \__enumext_anspic_print:n
  {
    \clist_map_function:nN {#1} \__enumext_anspic_row:n
  }
\cs_generate_variant:Nn \__enumext_anspic_print:n { e, V }
```

The function `\__enumext_anspic_row:n` will set the *widths* for the `minipage` environments and place *all arguments* passed to `\anspic` *saved* in the `\l__enumext_anspic_args_seq` sequence inside them. After each row `\nointerlineskip` avoids the space between lines, so the separation between rows is exactly the value of `\parsep` set by the key `layout-sep`.

```
\cs_new_protected:Nn \__enumext_anspic_row:n
  {
    \dim_set:Nn \l__enumext_anspic_mini_width_dim { \linewidth / #1 }
    \int_set:Nn \l__enumext_anspic_above_int { \l__enumext_anspic_below_int }
    \int_set:Nn \l__enumext_anspic_below_int { \l__enumext_anspic_above_int + #1 }
    \int_step_inline:nnn
      { \l__enumext_anspic_above_int + 1 }
      { \l__enumext_anspic_below_int }
```

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```
      {
        \IfDocumentMetadataT
          {
            \tag_suspend:n {minipage}
          }
        \begin{minipage}[ \l__enumext_anspic_mini_pos_str ]{
          \l__enumext_anspic_mini_width_dim }
          \centering
          \seq_item:Nn \l__enumext_anspic_args_seq {##1}
        \end{minipage}
        \IfDocumentMetadataT
          {
            \tag_resume:n {minipage}
          }
      }
    \par
    \nointerlineskip
  }
```

The `\__enumext_anspic_exec:` function will execute all the code in the `\anspic` command in the second argument of the `keyanspic` environment definition. If the key `layout-sty` is not set, everything will be printed on a *single line*.

```
\cs_new_protected:Nn \__enumext_anspic_exec:
  {
    \tl_if_empty:NTF \l__enumext_anspic_layout_style_tl
      {
        \__enumext_anspic_print:e { \seq_count:N \l__enumext_anspic_args_seq }
      }
      {
        \__enumext_anspic_print:V \l__enumext_anspic_layout_style_tl
      }
  }
```

(*End of definition for* `\__enumext_anspic_body_dim:n` *and others.*)

`\anspic` The command accepts a *starred argument* '`*`' in '`#1`', an optional `[`⟨*content*⟩`]` in '`#2`' and a mandatory `{`⟨*drawing or tabular*⟩`}` in '`#3`'. The command is active in the `keyanspic` environment only if the `save-ans` key is present, otherwise an error is returned. The three arguments are handled by the function `\__enumext_anspic_args:nnn` and stored in the sequence `\l__enumext_anspic_args_seq` which is processed by the `keyanspic` environment.

```
\NewDocumentCommand \anspic { s o +m }
  {
    \bool_lazy_or:nnF { \l__enumext_store_active_bool } { \__enumext_in_keyans_p: }
      {
        \msg_error:nnnn { enumext } { wrong-place }{ keyanspic }{ save-ans }
      }
    \int_compare:nNnT { \l__enumext_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { keyanspic-wrong-level }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_int } = { 1 }
      {
        \msg_error:nnnn { enumext } { command-wrong-place }{ anspic }{ keyans }
      }
    \seq_put_right:Nn \l__enumext_anspic_args_seq
      {
        \__enumext_anspic_args:nnn {#1} {#2} {#3}
      }
  }
```

(*End of definition for* `\anspic`. *This function is documented on page 19.*)

13.47 The horizontal environments

Generating *horizontal list environments* is NOT as simple as standard LaTeX list environments. The fundamental part of the code is adapted from the `shortlst` package to a more modern version using `expl3`[20]. It is not possible to redefine `\item` and `\makelabel` using `\RenewDocumentCommand` as in the vertical *non starred* versions.

To achieve the *horizontal list environments*, the `\item` command and its ⟨*content*⟩ are captured in a *horizontal box* using `\makebox` for the `label` and a `minipage` environment for the ⟨*content*⟩ passed to `\item`; the

optional argument (⟨*number*⟩) is also added to `\item` to be able to *join columns* horizontally. In simple terms, the goal is for `\item` to behave in the same way as in the `enumext` environment but with an additional *first optional argument* (⟨*number*⟩).

Since `\item` is not redefined with `\RenewDocumentCommand`, the original definition of the kernel is replaced by the one of the horizontal environment. The original is not lost, a copy is made at the beginning of the document and `\item` is turned into a *switch* that decides which of the two definitions must be run, as explained in §13.48.2. Because of this, the *standard list environments* and any environment defined using base `list` or `\trivlist` can be used in the ⟨*content*⟩ of the items of `enumext*` and `keyans*`: `itemize`, `enumerate`, `description`, `quote`, `quotation`, `verse`, `list`, `center`, `flushleft`, `flushright`, `trivlist`, `tabbing`, `verbatim` and all environments created with `\newtheorem`.

- When `item-break` is active and the item occupies the whole row, the content of the item is not captured in a *horizontal box* or in a `minipage`, but it is typeset directly in the vertical list (§13.48.4).
- For compatibility with the *tagged* PDF, the environments are closed according to the presence or not of the `mini-env` key.

13.47.1 Definition of variables

`\l__enumext_joined_item_X_int`
`\l__enumext_joined_item_aux_X_int`
`\l__enumext_tmpa_X_int`
`\l__enumext_item_width_X_dim`
`\g__enumext_minipage_active_X_bool`
`\l__enumext_miniright_code_X_box`

Internal variables used by `enumext*` and `keyans*` environments. The functions that calculate the item box width and join the item columns use the integers `\l__enumext_joined_item_X_int` and `\l__enumext_joined_item_aux_X_int`, the integer `\l__enumext_tmpa_X_int` and the dimension `\l__enumext_item_width_X_dim`. The keys `mini-env`, `mini-right` and `mini-right*` (§13.47.5) use the boolean `\g__enumext_minipage_active_X_bool` and the box `\l__enumext_miniright_code_X_box`.

```
\cs_set_protected:Nn \__enumext_tmp:n
  {
    \int_new:c  { l__enumext_joined_item_ #1 _int      }
    \int_new:c  { l__enumext_joined_item_aux_ #1 _int  }
    \int_new:c  { l__enumext_tmpa_ #1 _int             }
    \dim_new:c  { l__enumext_item_width_ #1 _dim       }
    \bool_new:c { g__enumext_minipage_active_ #1 _bool }
    \box_new:c  { l__enumext_miniright_code_ #1 _box   }
  }
\clist_map_inline:nn { vii, viii } { \__enumext_tmp:n {#1} }
```

(*End of definition for* `\l__enumext_joined_item_X_int` *and others.*)

13.47.2 Definition of error messages

`nested-horizontal`
`item-joined`
`item-joined-columns`

Messages used by `enumext*` and `keyans*` environments.

```
\msg_new:nnnn { enumext } { nested-horizontal }
  {
    The~environment~\l__enumext_envir_name_tl \c_space_tl can't~be~nested~in~'#1'~
    \msg_line_context:.
  }
  {
    'enumext*'~and~'keyans*'~are~horizontal~lists~and~can't~be~
    inside~each~other.
  }
\msg_new:nnn { enumext } { item-joined }
  {
    Items~joined~(#1)~>~#2~columns~\msg_line_context:.
  }
\msg_new:nnn { enumext } { item-joined-columns }
  {
    Not~enough~space~to~join~items~(#1)~>~#2~\msg_line_context:.
  }
```

(*End of definition for* `nested-horizontal`, `item-joined`, *and* `item-joined-columns`.)

13.47.3 Functions for item box width

`\__enumext_starred_columns_set_vii:`
`\__enumext_starred_columns_set_viii:`

Sets the default value for the *width of the box* containing the ⟨*content*⟩ of the items for `enumext*` environment.

```
\cs_new_protected:Nn \__enumext_starred_columns_set_vii:
  {
    \dim_compare:nNnT { \l__enumext_columns_sep_vii_dim } = { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_columns_sep_vii_dim
          {
            ( \l__enumext_labelwidth_vii_dim + \l__enumext_labelsep_vii_dim )
            / \l__enumext_columns_vii_int
```

```
5287            }
5288        }
5289      \int_set:Nn \l__enumext_tmpa_vii_int { \l__enumext_columns_vii_int - 1 }
5290      \dim_set:Nn \l__enumext_item_width_vii_dim
5291        {
5292          ( \linewidth - \l__enumext_columns_sep_vii_dim * \l__enumext_tmpa_vii_int )
5293          / \l__enumext_columns_vii_int
5294          - \l__enumext_labelwidth_vii_dim
5295          - \l__enumext_labelsep_vii_dim
5296        }
```

When the key `rightmargin` is active the values must be adjusted.

```
5297      \dim_compare:nNnT { \l__enumext_rightmargin_vii_dim } > { \c_zero_dim }
5298        {
5299          \dim_sub:Nn \l__enumext_item_width_vii_dim
5300            {
5301              ( \l__enumext_rightmargin_vii_dim * \l__enumext_tmpa_vii_int )
5302              / \l__enumext_columns_vii_int
5303            }
5304          \dim_add:Nn \l__enumext_columns_sep_vii_dim
5305            {
5306              \l__enumext_rightmargin_vii_dim
5307            }
5308        }
5309    }
```

Same implementation for the `keyans*` environment.

```
5310  \cs_new_protected:Nn \__enumext_starred_columns_set_viii:
5311    {
5312      \dim_compare:nNnT { \l__enumext_columns_sep_viii_dim } = { \c_zero_dim }
5313        {
5314          \dim_set:Nn \l__enumext_columns_sep_viii_dim
5315            {
5316              ( \l__enumext_labelwidth_viii_dim + \l__enumext_labelsep_viii_dim )
5317              / \l__enumext_columns_viii_int
5318            }
5319        }
5320      \int_set:Nn \l__enumext_tmpa_viii_int { \l__enumext_columns_viii_int - 1 }
5321      \dim_set:Nn \l__enumext_item_width_viii_dim
5322        {
5323          ( \linewidth - \l__enumext_columns_sep_viii_dim * \l__enumext_tmpa_viii_int )
5324          / \l__enumext_columns_viii_int
5325          - \l__enumext_labelwidth_viii_dim
5326          - \l__enumext_labelsep_viii_dim
5327        }
5328      \dim_compare:nNnT { \l__enumext_rightmargin_viii_dim } > { \c_zero_dim }
5329        {
5330          \dim_sub:Nn \l__enumext_item_width_viii_dim
5331            {
5332              ( \l__enumext_rightmargin_viii_dim * \l__enumext_tmpa_viii_int )
5333              / \l__enumext_columns_viii_int
5334            }
5335          \dim_add:Nn \l__enumext_columns_sep_viii_dim
5336            {
5337              \l__enumext_rightmargin_viii_dim
5338            }
5339        }
5340    }
```

(*End of definition for* `\__enumext_starred_columns_set_vii:` *and* `\__enumext_starred_columns_set_viii:`.)

13.47.4 Functions for join item columns

`\__enumext_starred_joined_item_vii:n`
`\__enumext_starred_joined_item_viii:n`

The *width* of the box in which the ⟨*content*⟩ passed to `\item`(⟨*columns*⟩) will be stored, together with the value of `\itemwidth` for the `enumext*` environment, is set by the functions `\__enumext_starred_joined_item_vii:n` and `\__enumext_starred_joined_item_viii:n`.

```
5341  \cs_new_protected:Nn \__enumext_starred_joined_item_vii:n
5342    {
5343      \int_set:Nn \l__enumext_joined_item_vii_int {#1}
5344      \int_compare:nNnT
```

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```
      { \l__enumext_joined_item_vii_int } > { \l__enumext_columns_vii_int }
      {
        \msg_warning:nnee { enumext } { item-joined }
          { \int_use:N \l__enumext_joined_item_vii_int }
          { \int_use:N \l__enumext_columns_vii_int }
        \int_set:Nn \l__enumext_joined_item_vii_int
          {
            \l__enumext_columns_vii_int - \l__enumext_item_column_pos_vii_int + 1
          }
      }
    \int_compare:nNnT
      { \l__enumext_joined_item_vii_int }
        >
      { \l__enumext_columns_vii_int - \l__enumext_item_column_pos_vii_int + 1 }
      {
        \msg_warning:nnee { enumext } { item-joined-columns }
          { \int_use:N \l__enumext_joined_item_vii_int }
          {
            \int_eval:n
              { \l__enumext_columns_vii_int - \l__enumext_item_column_pos_vii_int + 1 }
          }
        \int_set:Nn \l__enumext_joined_item_vii_int
          {
            \l__enumext_columns_vii_int - \l__enumext_item_column_pos_vii_int + 1
          }
      }
    \int_compare:nNnTF { \l__enumext_joined_item_vii_int } > { 1 }
      {
        \int_set_eq:NN
          \l__enumext_joined_item_aux_vii_int \l__enumext_joined_item_vii_int
        \int_decr:N \l__enumext_joined_item_aux_vii_int
        \int_add:Nn \l__enumext_item_column_pos_vii_int
          { \l__enumext_joined_item_aux_vii_int }
        \int_gadd:Nn \g__enumext_item_count_all_vii_int
          { \l__enumext_joined_item_aux_vii_int }
        \dim_set:Nn \l__enumext_joined_width_vii_dim
          {
            \l__enumext_item_width_vii_dim * \l__enumext_joined_item_vii_int
            + (
                \l__enumext_labelwidth_vii_dim + \l__enumext_labelsep_vii_dim
                + \l__enumext_columns_sep_vii_dim
              ) * \l__enumext_joined_item_aux_vii_int
          }
        \dim_set_eq:NN \itemwidth \l__enumext_joined_width_vii_dim
      }
      {
        \dim_set_eq:NN \l__enumext_joined_width_vii_dim \l__enumext_item_width_vii_dim
        \dim_set_eq:NN \itemwidth \l__enumext_item_width_vii_dim
      }
  }
```

Same implementation for the `keyans*` environment.

```
\cs_new_protected:Nn \__enumext_starred_joined_item_viii:n
  {
    \int_set:Nn \l__enumext_joined_item_viii_int {#1}
    \int_compare:nNnT { \l__enumext_joined_item_viii_int } >
      { \l__enumext_columns_viii_int }
      {
        \msg_warning:nnee { enumext } { item-joined }
          { \int_use:N \l__enumext_joined_item_viii_int }
          { \int_use:N \l__enumext_columns_viii_int }
        \int_set:Nn \l__enumext_joined_item_viii_int
          {
            \l__enumext_columns_viii_int - \l__enumext_item_column_pos_viii_int + 1
          }
      }
    \int_compare:nNnT
      { \l__enumext_joined_item_viii_int }
        >
      { \l__enumext_columns_viii_int - \l__enumext_item_column_pos_viii_int + 1 }
      {
```

```
      \msg_warning:nnee { enumext } { item-joined-columns }
        { \int_use:N \l__enumext_joined_item_viii_int }
        {
          \int_eval:n
            { \l__enumext_columns_viii_int - \l__enumext_item_column_pos_viii_int + 1 }
        }
      \int_set:Nn \l__enumext_joined_item_viii_int
        {
          \l__enumext_columns_viii_int - \l__enumext_item_column_pos_viii_int + 1
        }
    }
  \int_compare:nNnTF { \l__enumext_joined_item_viii_int } > { 1 }
    {
      \int_set_eq:NN
        \l__enumext_joined_item_aux_viii_int \l__enumext_joined_item_viii_int
      \int_decr:N \l__enumext_joined_item_aux_viii_int
      \int_add:Nn \l__enumext_item_column_pos_viii_int
        { \l__enumext_joined_item_aux_viii_int }
      \int_gadd:Nn \g__enumext_item_count_all_viii_int
        { \l__enumext_joined_item_aux_viii_int }
      \dim_set:Nn \l__enumext_joined_width_viii_dim
        {
          \l__enumext_item_width_viii_dim * \l__enumext_joined_item_viii_int
          + ( \l__enumext_labelwidth_viii_dim + \l__enumext_labelsep_viii_dim
              + \l__enumext_columns_sep_viii_dim
            )*\l__enumext_joined_item_aux_viii_int
        }
      \dim_set_eq:NN \itemwidth \l__enumext_joined_width_viii_dim
    }
    {
      \dim_set_eq:NN \l__enumext_joined_width_viii_dim \l__enumext_item_width_viii_dim
      \dim_set_eq:NN \itemwidth \l__enumext_item_width_viii_dim
    }
}
```

(*End of definition for* `\__enumext_starred_joined_item_vii:n` *and* `\__enumext_starred_joined_item_viii:n`.)

13.47.5 Functions for `mini-env`, `mini-right` and `mini-right*` keys

`\__enumext_start_mini_vii:`
`\__enumext_stop_mini_vii:`

The implementation of the `mini-env` key support is almost identical to the one used in the `enumext` and `keyans` environments, the difference is that the `\__enumext_mini_page` environment on the *"right side"* is executed *"after"* closing the environment, so it is necessary to make a global copy of the variable `\l__enumext_minipage_right_vii_dim` in the variable `\g__enumext_minipage_right_vii_dim`.

```
\cs_new_protected:Nn \__enumext_start_mini_vii:
  {
    \dim_compare:nNnT { \l__enumext_minipage_right_vii_dim } > { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_minipage_left_vii_dim
          {
            \linewidth
            - \l__enumext_minipage_right_vii_dim
            - \l__enumext_minipage_hsep_vii_dim
          }
        \bool_set_true:N \l__enumext_minipage_active_vii_bool
        \dim_gset_eq:NN
          \g__enumext_minipage_right_vii_dim
          \l__enumext_minipage_right_vii_dim
        \__enumext_mini_addvspace_vii:
        \nointerlineskip\noindent
        \__enumext_mini_page{ \l__enumext_minipage_left_vii_dim }
      }
  }
```

The function `\__enumext_stop_mini_vii:` closes the `\__enumext_mini_page` environment on the *"left side"*, applies `\hfill` and sets the variable `\g__enumext_minipage_active_vii_bool` to `true` which will be used in the function `\__enumext_after_env:nn` to execute the `minipage` on the *"right side"*. At this point the `\__enumext_stop_list:` and `\__enumext_stop_store_level_vii:` functions are executed, stopping the `list` environment and the level saving mechanism for storage in *sequence* of the `\anskey` command and `anskey*` environment. This function is passed to the `\__enumext_after_list_vii:` function in the second part of the `enumext*` environment definition (§13.48). Before closing the `\__enumext_mini_page` the function `\__enumext_mini_capture_end:` stores the space *"below"*.

```
\cs_new_protected:Nn \__enumext_stop_mini_vii:
```

```
  {
    \bool_if:NTF \l__enumext_minipage_active_vii_bool
      {
        \__enumext_stop_list:
        \__enumext_stop_store_level_vii:
        \__enumext_mini_capture_end:
        \IfDocumentMetadataT { \tag_resume:n {enumext*} }
        \end__enumext_mini_page
        \hfill
        \bool_gset_true:N \g__enumext_minipage_active_vii_bool
      }
      {
        \__enumext_stop_list:
        \__enumext_stop_store_level_vii:
      }
  }
```

(*End of definition for* `\__enumext_start_mini_vii:` *and* `\__enumext_stop_mini_vii:`.)

Finally the {⟨*code*⟩} passed to the `mini-right` or `mini-right*` keys and stored in the variable `\g__enumext_miniright_code_vii_tl` is executed in the `minipage` environment on the *"right side"*. For compatibility with the `caption` package and possibly other {⟨*code*⟩} passed to this key, it is passed to a box and then printed. Once the `minipage` on the *"right side"* is closed, `\__enumext_mini_apply_end:` adds the stored space *"below"*. This minipage is opened after the environment has ended, so it is placed in a group; otherwise the assignments that LaTeX makes when *tagging* PDF is active (for example, the one that makes a heading warn that it is inside a box) would remain active after the list.

```
\__enumext_after_env:nn {enumext*}
  {
    \bool_if:NT \g__enumext_minipage_active_vii_bool
      {
        \group_begin:
        \__enumext_minipage:w [ t ] { \g__enumext_minipage_right_vii_dim }
          \legacy_if_gset_false:n { @minipage }
          \skip_vertical:N \c_zero_skip
          \par\addvspace { \g__enumext_minipage_right_skip }
          \bool_if:NF \g__enumext_minipage_center_vii_bool
            {
              \tl_gput_left:Nn \g__enumext_miniright_code_vii_tl
                {
                  \centering
                }
            }
          \vbox_set_top:Nn \l__enumext_miniright_code_vii_box
            {
              \tl_use:N \g__enumext_miniright_code_vii_tl
            }
          \box_use_drop:N \l__enumext_miniright_code_vii_box
          \skip_vertical:N \c_zero_skip
        \__enumext_endminipage:
        \group_end:
        \__enumext_mini_apply_end:
      }
    \bool_gset_false:N \g__enumext_minipage_active_vii_bool
    \bool_gset_true:N \g__enumext_minipage_center_vii_bool
    \tl_gclear:N \g__enumext_miniright_code_vii_tl
    \dim_gzero:N \g__enumext_minipage_right_vii_dim
    \bool_gset_false:N \g__enumext_starred_bool
  }
```

`\__enumext_start_mini_viii:`
`\__enumext_stop_mini_viii:`

The implementation of the `mini-env`, `mini-right` and `mini-right*` keys is identical to the one used in the `enumext*` environment.

```
\cs_new_protected:Nn \__enumext_start_mini_viii:
  {
    \dim_compare:nNnT { \l__enumext_minipage_right_viii_dim } > { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_minipage_left_viii_dim
          {
            \linewidth
            - \l__enumext_minipage_right_viii_dim
            - \l__enumext_minipage_hsep_viii_dim
```

```
      }
    \bool_set_true:N \l__enumext_minipage_active_viii_bool
    \dim_gset_eq:NN
      \g__enumext_minipage_right_viii_dim
      \l__enumext_minipage_right_viii_dim
    \__enumext_mini_addvspace_viii:
    \nointerlineskip\noindent
    \__enumext_mini_page{ \l__enumext_minipage_left_viii_dim }
  }
}
\cs_new_protected:Nn \__enumext_stop_mini_viii:
{
  \bool_if:NTF \l__enumext_minipage_active_viii_bool
    {
      \__enumext_stop_list:
      \__enumext_mini_capture_end:
      \IfDocumentMetadataT { \tag_resume:n {keyans*} }
      \end__enumext_mini_page
      \hfill
      \bool_gset_true:N \g__enumext_minipage_active_viii_bool
    }
    {
      \__enumext_stop_list:
    }
}
\__enumext_after_env:nn {keyans*}
{
  \bool_if:NT \g__enumext_minipage_active_viii_bool
    {
      \group_begin:
      \__enumext_mini_page{ \g__enumext_minipage_right_viii_dim }
        \par\addvspace { \g__enumext_minipage_right_skip }
        \bool_if:NF \g__enumext_minipage_center_viii_bool
          {
            \tl_gput_left:Nn \g__enumext_miniright_code_viii_tl
              {
                \centering
              }
          }
        \vbox_set_top:Nn \l__enumext_miniright_code_viii_box
          {
            \tl_use:N \g__enumext_miniright_code_viii_tl
          }
        \box_use_drop:N \l__enumext_miniright_code_viii_box
      \end__enumext_mini_page
      \group_end:
      \__enumext_mini_apply_end:
    }
  \bool_gset_false:N \g__enumext_minipage_active_viii_bool
  \bool_gset_true:N \g__enumext_minipage_center_viii_bool
  \tl_gclear:N \g__enumext_miniright_code_viii_tl
  \dim_gzero:N \g__enumext_minipage_right_viii_dim
}
```

(*End of definition for* `\__enumext_start_mini_viii:` *and* `\__enumext_stop_mini_viii:`.)

13.48 The environment `enumext*`

`enumext*`

The environment accepts an optional [⟨*key* = *val*⟩] argument in '`#1`' that is processed after checking where it is running. The environment is generated and a temporary definition is given to `\__enumext_stop_item_tmp_vii:` equal to `\__enumext_first_item_tmp_vii:` and next to `\item` equal to the switch `\__enumext_item_switch_vii:` (§13.48.2), which decides whether `\item` belongs to `enumext*` (`\__enumext_start_item_tmp_vii:`, redefined later) or to a standard list nested inside it; the nesting depth of the `enumext*` environment is stored in `\l__enumext_base_depth_int`. Unlike the implementation used by the `shortlst` package, the values of `\rightskip` and `\@rightskip` are not set equal to `\@flushglue`, whose value is `0.0pt plus 1.0 fil`; in the tests performed this fails in some circumstances and different results are obtained when using pdfTEX and LuaTEX.

```
\NewDocumentEnvironment{enumext*}{ o }
  {
    \__enumext_safe_exec_vii:
```

```
    \__enumext_parse_keys_vii:n {#1}
    \__enumext_before_list_vii:
    \__enumext_start_store_level_vii:
    \__enumext_nested_save:
    \__enumext_start_list:nn { }
      {
        \__enumext_list_arg_two_vii:
        \__enumext_before_keys_exec_vii:
      }
    \IfDocumentMetadataT { \tag_suspend:n {enumext*} }
    \__enumext_starred_columns_set_vii:
    \item[] \scan_stop:
```

For compatibility with *tagged* PDF in LaTeX release 2026-06-01, `\setcounter` is set at this point in the environment definition, thereby avoiding the problem reported by Tim Prescott (@teepeemm) in enumext* nested in enumext starts at 2 with DocumentMetadata this was caused by the `latex-lab-block`[15] update in this release.

```
    \setcounter { enumXvii }
      { \int_eval:n { \int_use:c { l__enumext_start_vii_int } - 1 } }
    \cs_set_eq:NN \__enumext_stop_item_tmp_vii: \__enumext_first_item_tmp_vii:
    \cs_set_eq:NN \item \__enumext_item_switch_vii:
    \int_set:Nn \l__enumext_base_depth_int { \@listdepth }
    \bool_set_false:N \l__enumext_trivlist_bool
    \ignorespaces
  }
  {
    % {tag=text-unit}
    \IfDocumentMetadataT { \tag_struct_end:n {tag=semantic-para} }
    \__enumext_stop_item_tmp_vii:
    \__enumext_remove_extra_parsep_vii:
    \__enumext_after_list_vii:
  }
```

(*End of definition for* `enumext*`. *This function is documented on page* 5.)

`\__enumext_safe_exec_vii:`

The function `\__enumext_is_not_nested:` is called first, which sets `\g__enumext_starred_bool` to true if it is NOT nested within `enumext`; then the function `\__enumext_internal_mini_page:` is called to create the environment `\__enumext_mini_page`, `\l__enumext_level_h_int` is incremented to restrict nesting of the environment, `\l__enumext_starred_bool` is set to true, and finally the function `\__enumext_is_on_first_level:` is called, which sets `\l__enumext_starred_first_bool` to true if it is not nested, allowing the *"storage system"* to be used.

```
\cs_new_protected:Nn \__enumext_safe_exec_vii:
  {
    \__enumext_is_not_nested:
    \__enumext_internal_mini_page:
    \int_incr:N \l__enumext_level_h_int
    \int_compare:nNnT { \l__enumext_level_h_int } > { 1 }
      {
        \msg_error:nn { enumext } { nested }
      }
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } = { 1 }
      {
        \msg_error:nnn { enumext } { nested-horizontal } { keyans*}
      }
    \bool_set_true:N \l__enumext_starred_bool
    \bool_set_false:N \l__enumext_standard_bool
    \__enumext_is_on_first_level:
  }
```

(*End of definition for* `\__enumext_safe_exec_vii:`.)

`\__enumext_parse_keys_vii:n`

It first checks the state of the variable `\l__enumext_resume_count_vii_bool` set by the key `resume` and calls the function `\__enumext_resume_last_counter:` if it is `true`, then clears the variable `\l__enumext_series_name_str` used by the key `series`, processes the environment `[⟨key = val⟩]` and executes the function `\__enumext_parse_series:n` used by the key `series`, then executes the function `\__enumext_store_active_keys_vii:n` and reprocesses the ⟨*keys*⟩ to pass them to the storage *sequence* if the key `save-key` is not active.

Here it is necessary to check the status of `\l__enumext_resume_count_vii_bool` in case the key `resume` is set using `\setenumext{enumext*}{resume}`.

```
\cs_new_protected:Nn \__enumext_parse_keys_vii:n
```

```
  {
    \bool_if:NT \l__enumext_resume_count_vii_bool
      {
        \__enumext_resume_last_counter:
      }
    \tl_if_novalue:nF {#1}
      {
        \str_clear:N \l__enumext_series_name_str
        \keys_set:nn { enumext / enumext* } {#1}
        \bool_if:NF \l__enumext_print_keyans_cmd_bool
          {
            \__enumext_parse_series:n {#1}
          }
        \__enumext_store_active_keys_vii:n {#1}
      }
  }
```

(*End of definition for* `\__enumext_parse_keys_vii:n`.)

`\__enumext_before_list_vii:`

The function `\__enumext_before_list_vii:` first calls the function `\__enumext_vspace_above_vii:` used by the keys `above` and `above*`, then calls the function `\__enumext_check_ans_active:` for the check answer mechanism and finally calls the functions `\__enumext_before_args_exec_vii:` and `\__enumext_start_mini_vii:` used by the keys `before*`, `mini-env`, `mini-right` and `mini-right*`.

```
\cs_new_protected:Nn \__enumext_before_list_vii:
  {
    \__enumext_vspace_above_vii:
    \__enumext_check_ans_active:
    \__enumext_before_args_exec_vii:
    \__enumext_start_mini_vii:
  }
```

(*End of definition for* `\__enumext_before_list_vii:`.)

`\__enumext_after_list_vii:`

The function `\__enumext_after_list_vii:` first calls `\__enumext_stop_mini_vii:`, which internally calls `\__enumext_stop_list:` and `\__enumext_stop_store_level_vii:` (§13.47.5) used by the keys `mini-env`, `mini-right` and `mini-right*`. Then it calls `\__enumext_after_stop_list_vii:`, used by the key `after`. After that it calls `\__enumext_check_ans_key_hook:`, used by the key `check-ans`, and `\__enumext_vspace_below_vii:`, used by the keys `below` and `below*`. Finally it sets `\l__enumext_starred_bool` to false and calls `\__enumext_starred_save_counter:`, used by the `series`, `resume` and `resume*` keys.

```
\cs_new_protected:Nn \__enumext_after_list_vii:
  {
    \__enumext_stop_mini_vii:
    \__enumext_after_stop_list_vii:
    \__enumext_check_ans_key_hook:
    \__enumext_vspace_below_vii:
    \bool_set_false:N \l__enumext_starred_bool
    \bool_if:NF \l__enumext_print_keyans_cmd_bool
      {
        \__enumext_starred_save_counter:
      }
  }
```

(*End of definition for* `\__enumext_after_list_vii:`.)

`\__enumext_start_store_level_vii:`
`\__enumext_stop_store_level_vii:`

The `\__enumext_start_store_level_vii:` and `\__enumext_stop_store_level_vii:` functions activate the *"storing structure"* mechanism in *sequence* for `\anskey` command and `anskey*` environment if `enumext*` are nested in `enumext`.

```
\cs_new_protected:Nn \__enumext_start_store_level_vii:
  {
    \bool_if:NT \l__enumext_store_active_bool
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 0 }
          {
            \__enumext_store_level_open_vii:
          }
      }
  }
\cs_new_protected:Nn \__enumext_stop_store_level_vii:
```

```
  {
    \bool_if:NT \l__enumext_store_active_bool
      {
        \int_compare:nNnT { \l__enumext_level_int } > { 0 }
          {
            \__enumext_store_level_close_vii:
          }
      }
  }
```

(*End of definition for* `\__enumext_start_store_level_vii:` *and* `\__enumext_stop_store_level_vii:`.)

13.48.1 The command `\item` in `enumext*`

`\__enumext_first_item_tmp_vii:`

The `\__enumext_first_item_tmp_vii:` function will remove horizontal space equal to `\labelwidth` plus `\labelsep` to the left of the *"first"* `\item` in the environment at the point of execution of this function, where it is equal to the `\__enumext_stop_item_tmp_vii:` function inside the environment body definition.

```
\cs_new_protected_nopar:Nn \__enumext_first_item_tmp_vii:
  {
    \skip_horizontal:n
      {
        -\l__enumext_labelwidth_vii_dim - \l__enumext_labelsep_vii_dim
      }
    \ignorespaces
  }
```

(*End of definition for* `\__enumext_first_item_tmp_vii:`.)

`\__enumext_start_item_tmp_vii:`
`\__enumext_item_peek_args_vii:`
`\__enumext_joined_item_vii:w`
`\__enumext_standard_item_vii:w`
`\__enumext_starred_item_vii:w`
`\__enumext_starred_item_vii_aux_i:w`
`\__enumext_starred_item_vii_aux_ii:w`
`\__enumext_starred_item_vii_aux_iii:w`

First the function `\__enumext_stop_item_tmp_vii:` is called, which is redefined later, then the value of `\l__enumext_item_column_pos_vii_int`, which counts the items by rows, and the value of `\g__enumext_item_count_all_vii_int`, which counts the total of items in the environment, are incremented. After that the function `\__enumext_item_peek_args_vii:` is called, which handles the arguments passed to `\item`.

```
\cs_new_protected_nopar:Nn \__enumext_start_item_tmp_vii:
  {
    \__enumext_stop_item_tmp_vii:
    \int_incr:N \l__enumext_item_column_pos_vii_int
    \int_gincr:N \g__enumext_item_count_all_vii_int
    \__enumext_item_peek_args_vii:
  }
```

The function `\__enumext_item_peek_args_vii:` handles the `\item(`⟨*number*⟩`)`. It looks for the argument "`(`"; if it is present, it calls the function `\__enumext_joined_item_vii:w (`⟨*number*⟩`)`, which is in charge of joining the items in the same row; if it is not present, it sets the default value `(1)`.

```
\cs_new_protected:Nn \__enumext_item_peek_args_vii:
  {
    \peek_meaning:NTF (
      { \__enumext_joined_item_vii:w }
      { \__enumext_joined_item_vii:w (1) }
  }
```

The function `\__enumext_joined_item_vii:w` first sets the *width* of the box that stores the content passed to `\item` by calling `\__enumext_starred_joined_item_vii:n`. Then it looks for the argument "`*`"; if it is present, it calls `\__enumext_starred_item_vii:w`, otherwise `\__enumext_standard_item_vii:w`.

```
\cs_new_protected:Npn \__enumext_joined_item_vii:w (#1)
  {
    \__enumext_starred_joined_item_vii:n {#1}
    \peek_meaning_remove:NTF *
      { \__enumext_starred_item_vii:w  }
      { \__enumext_standard_item_vii:w }
  }
```

The function `\__enumext_standard_item_vii:w` will first look for the argument '`[`', if present it will set the state of the variable `\l__enumext_wrap_label_vii_bool` equal to the state of the variable `\l__enumext_wrap_label_opt_vii_bool` handled by the key `wrap-label*` and finally execute the *non-enumerated* version `\item[`⟨*custom*⟩`]` by means of the function `\__enumext_start_item_vii:w`; otherwise it sets the value of the variable `\l__enumext_wrap_label_vii_bool` handled by the `wrap-label` key to

true and set the switch \if@noitemarg to true to execute the enumerated version of \item by means of the function __enumext_start_item_vii:w [\l__enumext_label_vii_tl].

```
\cs_new_protected:Npn \__enumext_standard_item_vii:w
  {
    \bool_set_false:N \l__enumext_item_starred_vii_bool
    \peek_meaning:NTF [
      {
        \bool_set_eq:NN
          \l__enumext_wrap_label_vii_bool \l__enumext_wrap_label_opt_vii_bool
        \__enumext_start_item_vii:w
      }
      {
        \bool_set_true:N \l__enumext_wrap_label_vii_bool
        \legacy_if_set_true:n { @noitemarg }
        \__enumext_start_item_vii:w [ \l__enumext_label_vii_tl ] \ignorespaces
      }
  }
```

The function __enumext_starred_item_vii:w together with the specified auxiliary functions aux_i:w, aux_ii:w, and aux_iii:w execute \item*, \item*[⟨*symbol*⟩] and \item*[⟨*symbol*⟩][⟨*offset*⟩].

```
\cs_new_protected:Npn \__enumext_starred_item_vii:w
  {
    \bool_set_true:N \l__enumext_item_starred_vii_bool
    \bool_set_true:N \l__enumext_wrap_label_vii_bool
    \peek_meaning:NTF [
      { \__enumext_starred_item_vii_aux_i:w }
      { \__enumext_starred_item_vii_aux_ii:w }
  }
\cs_new_protected:Npn \__enumext_starred_item_vii_aux_i:w [#1]
  {
    \tl_gset:Nn \g__enumext_item_symbol_aux_vii_tl {#1}
    \__enumext_starred_item_vii_aux_ii:w
  }
\cs_new_protected:Npn \__enumext_starred_item_vii_aux_ii:w
  {
    \peek_meaning:NTF [
      { \__enumext_starred_item_vii_aux_iii:w }
      {
        \dim_set_eq:NN \l__enumext_item_symbol_sep_vii_dim \l__enumext_labelsep_vii_dim
        \legacy_if_set_true:n { @noitemarg }
        \__enumext_start_item_vii:w [ \l__enumext_label_vii_tl ] \ignorespaces
      }
  }
\cs_new_protected:Npn \__enumext_starred_item_vii_aux_iii:w [#1]
  {
    \dim_set:Nn \l__enumext_item_symbol_sep_vii_dim {#1}
    \legacy_if_set_true:n { @noitemarg }
    \__enumext_start_item_vii:w [ \l__enumext_label_vii_tl ] \ignorespaces
  }
```

(*End of definition for* __enumext_start_item_tmp_vii: *and others.*)

__enumext_fake_make_label_vii:n

The __enumext_fake_make_label_vii:n function will be in charge of handling the definition of \item. First it increments the counter enumXvii for the enumerated items and activates support for the *check answers* mechanism, followed by support for \item*[⟨*symbol*⟩][⟨*offset*⟩] if present, then the wrap-label and wrap-label* keys, executed using \makebox whose width is given by the labelwidth key and position by the align key; inside its argument it executes the font key together with the function defined by the wrap-label or wrap-label* keys. Finally it executes the labelsep key applying a \skip_horizontal:N and \ignorespaces.

For compatibility with *tagged* PDF and hyperref when an environment enumext is nested in enumext* and the key save-ans is not active need setting the \if@hyper@item switch to true. The explanation for this is given by the master Heiko Oberdiek on \refstepcounter{enumi} twice (or more) creates destination with the same identifier. This patch is only needed if you are running pdflatex and not if you are running lualatex

```
\cs_new_protected_nopar:Nn \__enumext_fake_make_label_vii:n
  {
    \legacy_if:nT { @noitemarg }
      {
        \legacy_if_set_false:n { @noitemarg }
```

```
      \legacy_if:nT { @nmbrlist }
        {
          \IfDocumentMetadataT
            {
              \bool_if:NT \l__enumext_hyperref_bool
                {
                  \legacy_if_set_true:n { @hyper@item }
                }
            }
          \refstepcounter{enumXvii}
          \bool_if:NT \l__enumext_check_answers_bool
            {
              \int_gincr:N \g__enumext_item_number_int
              \bool_set_true:N \l__enumext_item_number_bool
            }
        }
    }
  \bool_if:NT \l__enumext_item_starred_vii_bool
    {
      \tl_if_blank:VT \g__enumext_item_symbol_aux_vii_tl
        {
          \tl_gset_eq:NN
            \g__enumext_item_symbol_aux_vii_tl \l__enumext_item_symbol_vii_tl
        }
      \mode_leave_vertical:
      \skip_horizontal:n { -\l__enumext_item_symbol_sep_vii_dim }
      \hbox_overlap_left:n { \g__enumext_item_symbol_aux_vii_tl }
      \skip_horizontal:N \l__enumext_item_symbol_sep_vii_dim
      \tl_gclear:N \g__enumext_item_symbol_aux_vii_tl
    }
  \makebox[ \l__enumext_labelwidth_vii_dim ][ \l__enumext_align_label_vii_str ]
    {
      \tl_use:N \l__enumext_label_font_style_vii_tl
      \bool_if:NTF \l__enumext_wrap_label_vii_bool
        {
          \__enumext_wrapper_label_vii:n {#1}
        }
        {#1}
    }
  \skip_horizontal:N \l__enumext_labelsep_vii_dim \ignorespaces
}
```

(*End of definition for* `\__enumext_fake_make_label_vii:n`.)

13.48.2 The `\item` command inside nested lists

In the `enumext*` and `keyans*` environments `\item` is a *streaming* command: it closes the box of the previous item and opens the next one, so the `\item` of the environment and the `\item` of a list nested in the *"item content"*, for example `itemize`, run inside the same `minipage`. To distinguish them two things are used, depending on how the nested environment is built.

The environments based on `list` increase the depth of lists `\@listdepth`. This depth is stored in `\l__enumext_base_depth_int` when the environment starts and again after opening the `minipage` of an item, where the kernel resets it to zero. While `\@listdepth` is greater than the stored value `\item` belongs to the nested list and the copy `\__enumext_item_std:w` is executed; otherwise the *real* `\item` of the environment is executed.

The environments based on `\trivlist`, like `center` or the theorems, do not increase `\@listdepth`. For them the boolean `\l__enumext_trivlist_bool` is set to true by a wrapper of `\trivlist`. The assignment is local to the group of the nested environment, so the boolean is true while it is open and false again when it is closed, and the switch executes the copy `\__enumext_item_std:w` in the same way. The boolean is set to false when the environment starts and after opening each item.

The nested lists inherit `\labelwidth` and `\labelsep` from the group in which they are opened, which is the one of the `list` that defines `enumext*`, where they have the values of the keys `labelwidth` and `labelsep`. Without a correction the label of `itemize` would be displaced and the space after the label of `description` and of the theorems would change. The values that they have before starting the environment are saved in `\l__enumext_outer_labelwidth_dim` and `\l__enumext_outer_labelsep_dim`, and `\__enumext_nested_reset:` restores them after opening the `minipage` of the item, or inside the group of an item of `item-break`. The nested list is therefore typeset as if it were in a `minipage` at that point of the document. The other parameters of the list, like `\leftmargin` or `\itemindent`, are always set by the nested list.

\l__enumext_base_depth_int
\l__enumext_trivlist_bool
__enumext_trivlist_orig:
\l__enumext_outer_labelwidth_dim
\l__enumext_outer_labelsep_dim
__enumext_item_switch:N
__enumext_item_switch_vii:
__enumext_item_switch_viii:
__enumext_nested_save:
__enumext_nested_reset:

First the variables: the depth of lists of the environment, the boolean that is true inside an environment based on \trivlist and the values of \labelwidth and \labelsep before starting the environment.

```
\int_new:N  \l__enumext_base_depth_int
\bool_new:N \l__enumext_trivlist_bool
\dim_new:N  \l__enumext_outer_labelwidth_dim
\dim_new:N  \l__enumext_outer_labelsep_dim
```

The function __enumext_item_switch:N executes the copy of the kernel \item when the depth of lists is greater than the stored one or when the boolean is true, otherwise it executes the function in its argument, the real \item of the environment.

```
\cs_new_protected_nopar:Npn \__enumext_item_switch:N #1
  {
    \bool_lazy_or:nnTF
      { \int_compare_p:nNn { \@listdepth } > { \l__enumext_base_depth_int } }
      { \l__enumext_trivlist_bool }
      { \__enumext_item_std:w }
      { #1 }
  }
```

The function __enumext_nested_save: is run before the `list` of the environment is opened and __enumext_nested_reset: is run inside the item, after the label has been typeset; it stores the depth of lists, sets the boolean to false and restores the saved values.

```
\cs_new_protected_nopar:Nn \__enumext_nested_save:
  {
    \dim_set_eq:NN \l__enumext_outer_labelwidth_dim \labelwidth
    \dim_set_eq:NN \l__enumext_outer_labelsep_dim \labelsep
  }
\cs_new_protected_nopar:Nn \__enumext_nested_reset:
  {
    \int_set:Nn \l__enumext_base_depth_int { \@listdepth }
    \bool_set_false:N \l__enumext_trivlist_bool
    \dim_set_eq:NN \labelwidth \l__enumext_outer_labelwidth_dim
    \dim_set_eq:NN \labelsep \l__enumext_outer_labelsep_dim
  }
```

At the beginning of the document \trivlist is replaced by a version that runs the original one and then sets the boolean to true, inside the group of the environment. The `cmd` hooks of the kernel are not used for this because the patch of \trivlist fails when `PDF` tagging is active, with the error `Use of \__hook_make_-prefixes:w doesn't match its definition.`

```
\__enumext_at_begin_document:n
  {
    \cs_new_eq:NN \__enumext_trivlist_orig: \trivlist
    \cs_set_protected_nopar:Npn \trivlist
      {
        \__enumext_trivlist_orig:
        \bool_set_true:N \l__enumext_trivlist_bool
      }
  }
```

Finally the definition of \item in enumext* and keyans* respectively.

```
\cs_new_protected_nopar:Nn \__enumext_item_switch_vii:
  { \__enumext_item_switch:N \__enumext_start_item_tmp_vii: }
\cs_new_protected_nopar:Nn \__enumext_item_switch_viii:
  { \__enumext_item_switch:N \__enumext_start_item_tmp_viii: }
```

(*End of definition for* `\l__enumext_base_depth_int` *and others.*)

13.48.3 Real definition of \item in enumext*

The functions __enumext_start_item_vii:w and __enumext_stop_item_vii: executing the true definition of \item inside the enumext* environment, unlike the implementation in shortlst, no extra group is added around the *horizontal box* and the plain form of the lrbox environment, that is \hbox_set_to_wd:Nnw and \hbox_set_end:, is used instead of the lrbox environment.

__enumext_start_item_vii:w
__enumext_start_item_box_vii:w
__enumext_stop_item_vii:

The function __enumext_start_item_vii:w chooses how the item is built: if the key item-break is active and the item occupies the whole row, that is, the number of joined columns is equal to the value of columns after the adjustments of __enumext_starred_joined_item_vii:n, it calls

`\__enumext_start_item_break_vii:n` (§13.48.4), otherwise `\__enumext_start_item_box_vii:w`, described next.

In `\__enumext_start_item_box_vii:w` first the value of `\__enumext_stop_item_tmp_vii:` is set equal to `\__enumext_stop_item_vii:`, which is defined later; after that it starts capturing `\item` and *"item content"* in a *horizontal box* where the width will be `\itemwidth` plus `\labelwidth` plus `\labelsep`.

```
\cs_new_protected_nopar:Npn \__enumext_start_item_vii:w [#1]
  {
    \bool_lazy_and:nnTF
      { \l__enumext_item_break_vii_bool }
      {
        \int_compare_p:nNn
          { \l__enumext_joined_item_vii_int } = { \l__enumext_columns_vii_int }
      }
      { \__enumext_start_item_break_vii:n {#1} }
      { \__enumext_start_item_box_vii:w [#1] }
  }
\cs_new_protected_nopar:Npn \__enumext_start_item_box_vii:w [#1]
  {
    \cs_set_eq:NN \__enumext_stop_item_tmp_vii: \__enumext_stop_item_vii:
    \hbox_set_to_wd:Nnw \l__enumext_item_text_vii_box
      {
        \l__enumext_joined_width_vii_dim
        + \l__enumext_labelwidth_vii_dim
        + \l__enumext_labelsep_vii_dim
      }
```

Redefine the `\footnote` command.

```
      \__enumext_renew_footnote_starred:
```

Now the *sockets* for *tagging* PDF support are inserted and `\item` is run.

```
      \__enumext_start_list_tag:n {enumext*}
      \__enumext_fake_make_label_vii:n {#1}
      \__enumext_stop_start_list_tag:
```

Finally the `minipage` environment is opened, the *"item content"* is captured, `\parindent` takes the value of the key `listparindent` and `\parskip` takes the value of the key `parsep`, then the keys `itemindent` and `first` are executed. Inside the `minipage` `\@listdepth` is reset to zero, so the nesting depth is stored again in `\l__enumext_base_depth_int` right after opening it; this allows the switch (§13.48.2) to recognize standard lists nested in the item.

Here the use of `\__enumext_unskip_unkern:` (run twice) and `\skip_horizontal:n` with the value of `listparindent` is necessary, otherwise an unwanted space is created when using `\item[⟨opt⟩]` and the value passed to the key `itemindent` is incremented.

```
      \__enumext_minipage:w [ t ]{ \l__enumext_joined_width_vii_dim }
        \__enumext_nested_reset:
        \dim_set_eq:NN \parindent \l__enumext_listparindent_vii_dim
        \skip_set_eq:NN \parskip \l__enumext_parsep_vii_skip
        \__enumext_unskip_unkern:
        \__enumext_unskip_unkern:
        \skip_horizontal:n { -\l__enumext_listparindent_vii_dim } \ignorespaces
        \tl_use:N \l__enumext_fake_item_indent_vii_tl
        \tl_use:N \l__enumext_after_list_args_vii_tl
  }
```

The `\__enumext_stop_item_vii:` function will finish fetching `\item` and *"item content"* by closing the `minipage` environment, the *sockets* for *tagging* PDF and the *horizontal box*.

```
\cs_new_protected_nopar:Nn \__enumext_stop_item_vii:
  {
    \__enumext_endminipage:
    \__enumext_stop_list_tag:n {enumext*}
    \hbox_set_end:
```

Here the *warnings* are reduced a bit by setting the value of `\hbadness` to `10000`, print `\item` and *"item content"* from the *horizontal box*.

```
    \int_set:Nn \hbadness { 10000 }
    \box_use_drop:N \l__enumext_item_text_vii_box
```

Finally apply the *vertical space* between rows set by `itemsep` key passed to `\parsep` using `\par\noindent` and *horizontal space* between columns set by `columns-sep` key using `\skip_horizontal:N`.

```
    \int_compare:nNnTF
      { \l__enumext_item_column_pos_vii_int } = { \l__enumext_columns_vii_int }
      {
        \par\noindent
        \int_zero:N \l__enumext_item_column_pos_vii_int
      }
      {
        \skip_horizontal:N \l__enumext_columns_sep_vii_dim
      }
  }
```

(*End of definition for* `\__enumext_start_item_vii:w`, `\__enumext_start_item_box_vii:w`, *and* `\__enumext_stop_item_vii:`.)

13.48.4 Items without `minipage`: the `item-break` key

`\__enumext_start_item_break_vii:n`
`\__enumext_stop_item_break_vii:`

When the key `item-break` is active and the item occupies the whole row, the ⟨*content*⟩ is NOT captured in a *horizontal box*: it flows as the text of the list, so it can be broken between pages. The functions are the equivalent of `\__enumext_start_item_box_vii:w` and `\__enumext_stop_item_vii:` for this case.

The *label* is placed at the left of the row with a negative skip and the lines of the ⟨*content*⟩ are indented by the width of the `labelwidth` plus the `labelsep`. This is done the same way as the lists do: the width is added to `\@totalleftmargin`, subtracted from `\linewidth` and the paragraph shape is set again with `\parshape`. All the assignments to `\@totalleftmargin`, `\linewidth`, `\parshape`, `\parindent` and `\parskip` are local to the group that is opened here and closed in `\__enumext_stop_item_break_vii:` after the `\par` that ends the item. The *sockets* for *tagging* PDF are the same ones used by the items with box, but since there is no `minipage` to start the paragraph the marked content of the text is opened and closed by hand.

The first idea was to make the indentation with `\leftskip`, but that is not safe, because commands such as `\centering` or `\raggedright` set it to zero and the indentation is lost. The alternative used here is the one of the `list` environment, but `\@totalleftmargin` and `\linewidth` are internal parameters of the LaTeX kernel and relying on them is not correct practice, so the code must be reviewed if the kernel changes them. The technique of adjusting these parameters, instead of using a surrounding list, comes from the `indent`[16] package.

```
\cs_new_protected_nopar:Nn \__enumext_start_item_break_vii:n
  {
    \cs_set_eq:NN \__enumext_stop_item_tmp_vii: \__enumext_stop_item_break_vii:
    \group_begin:
      \dim_add:Nn \@totalleftmargin
        { \l__enumext_labelwidth_vii_dim + \l__enumext_labelsep_vii_dim }
      \dim_sub:Nn \linewidth
        { \l__enumext_labelwidth_vii_dim + \l__enumext_labelsep_vii_dim }
      \parshape \c_one_int \@totalleftmargin \linewidth
      \skip_horizontal:n
        { -\l__enumext_labelwidth_vii_dim - \l__enumext_labelsep_vii_dim }
      \__enumext_start_list_tag:n {enumext*}
      \__enumext_fake_make_label_vii:n {#1}
      \__enumext_nested_reset:
      \__enumext_stop_start_break_tag:
      \dim_set_eq:NN \parindent \l__enumext_listparindent_vii_dim
      \skip_set_eq:NN \parskip \l__enumext_parsep_vii_skip
      \tl_use:N \l__enumext_fake_item_indent_vii_tl
      \tl_use:N \l__enumext_after_list_args_vii_tl
  }
\cs_new_protected_nopar:Nn \__enumext_stop_item_break_vii:
  {
    \__enumext_stop_item_break_tag:n {enumext*}
    \par
    \group_end:
    \int_zero:N \l__enumext_item_column_pos_vii_int
    \noindent
  }
```

(*End of definition for* `\__enumext_start_item_break_vii:n` *and* `\__enumext_stop_item_break_vii:`.)

`\__enumext_remove_extra_parsep_vii:`

Remove the extra *vertical space* equal to `\parsep=\itemsep` when the total number of `\item` is divisible by the number of `\item` in the last row of the environment. Here the removal of the last ⟨*skip*⟩ with `\__enumext_unskip_unkern:`, `\unskip` or `\removelastskip` does not obtain the expected result, the extra space remains; the option is to add a negative ⟨*skip*⟩ with the value of `itemsep` using `\skip_vertical:n`,

the enumext interface of \vskip, after ending the paragraph with \para_end:, so that TEX is in ⟨*vertical mode*⟩ and the skip is applied directly to the vertical list. A zero skip is added after it and, finally, the counter of *all* the items is reset to zero.

```
\cs_new_protected:Nn \__enumext_remove_extra_parsep_vii:
  {
    \int_compare:nNnT
      {
        \int_mod:nn
          {  \g__enumext_item_count_all_vii_int } { \l__enumext_columns_vii_int }
      }
      =
      { 0 }
      {
        \para_end:
        \skip_vertical:n { -\l__enumext_itemsep_vii_skip }
        \skip_vertical:N \c_zero_skip
        \int_gzero:N \g__enumext_item_count_all_vii_int
      }
  }
```

(*End of definition for* __enumext_remove_extra_parsep_vii:.)

Since the check-ans check must not be executed by levels but on the complete list, it is taken out of the enumext* environment using the *"hook"* function __enumext_after_env:nn.

```
\__enumext_after_env:nn {enumext*}
  {
    \__enumext_execute_after_env:
  }
```

13.49 The environment keyans*

keyans*

The implementation of keyans* environment is the similar as that used by the enumext* environment except for the __enumext_check_starred_cmd:n function added in the second part. It accepts an optional [⟨*key = val*⟩] argument in '#1' that is processed after checking that the save-ans key is active and where the environment is running.

```
\NewDocumentEnvironment{keyans*}{ o }
  {
    \__enumext_safe_exec_viii:
    \__enumext_parse_keys_viii:n {#1}
    \__enumext_before_list_viii:
    \__enumext_nested_save:
    \__enumext_start_list:nn { }
      {
        \__enumext_list_arg_two_viii:
        \__enumext_before_keys_exec_viii:
      }
    \IfDocumentMetadataT { \tag_suspend:n {keyans*} }
    \__enumext_starred_columns_set_viii:
    \item[] \scan_stop:
    % Set start counter
    \setcounter { enumXviii }
      { \int_eval:n { \int_use:c { l__enumext_start_viii_int } - 1 } }
    \cs_set_eq:NN \__enumext_stop_item_tmp_viii: \__enumext_first_item_tmp_viii:
    \cs_set_eq:NN \item \__enumext_item_switch_viii:
    \int_set:Nn \l__enumext_base_depth_int { \@listdepth }
    \bool_set_false:N \l__enumext_trivlist_bool
    \ignorespaces
  }
  {
    % {tag=text-unit}
    \IfDocumentMetadataT { \tag_struct_end:n {tag=semantic-para} }
    \__enumext_stop_item_tmp_viii:
    \__enumext_remove_extra_parsep_viii:
    \__enumext_check_starred_cmd:n { item }
    \__enumext_after_list_viii:
  }
```

(*End of definition for* keyans*. *This function is documented on page* 18.)

__enumext_safe_exec_viii:

The __enumext_safe_exec_viii: function first checks if the save-ans key is active; only when this is true is the environment available. It increments the value of \l__enumext_keyans_level_h_int and returns an error message when the environment is nested, then calls the __enumext_keyans_name_and_start: function in charge of saving the name of the environment and the line it is running on, then checks if keyans* is being nested in enumext*, returning an error, and sets \l__enumext_starred_bool to true; finally it checks if it is at the appropriate level within the enumext environment.

```
\cs_new_protected:Nn \__enumext_safe_exec_viii:
  {
    \bool_lazy_or:nnF { \l__enumext_store_active_bool } { \__enumext_in_keyans_p: }
      {
        \msg_error:nnnn { enumext } { wrong-place }{ keyans* }{ save-ans }
      }
    \int_incr:N \l__enumext_keyans_level_h_int
    \int_compare:nNnT { \l__enumext_keyans_level_h_int } > { 1 }
      {
        \msg_error:nn { enumext } { nested }
      }
    \__enumext_keyans_name_and_start:
    \bool_if:NT \l__enumext_starred_bool
      {
        \msg_error:nnn { enumext } { nested-horizontal } { enumext* }
      }
    \bool_set_true:N \l__enumext_starred_bool
    % Set false for interfering with enumext nested in keyans*
    % (yes, its possible and crayze)
    \bool_set_false:N \l__enumext_store_active_bool
    \int_compare:nNnT { \l__enumext_level_int } > { 1 }
      {
        \msg_error:nn { enumext } { keyans-wrong-level }
      }
  }
```

(*End of definition for* __enumext_safe_exec_viii:.)

__enumext_parse_keys_viii:n

Parse [⟨*key* = *val*⟩] for keyans*.

```
\cs_new_protected:Nn \__enumext_parse_keys_viii:n
  {
    \tl_if_novalue:nF {#1}
      {
        \keys_set:nn { enumext / keyans* } {#1}
      }
  }
```

(*End of definition for* __enumext_parse_keys_viii:n.)

__enumext_before_list_viii:

The function __enumext_before_list_viii: will add the vertical spacing on the environment if the above key is active next to the {⟨*code*⟩} defined by the before* key if it is active (function __enumext_before_args_exec_viii:), then call the function __enumext_start_mini_viii: handled by mini-env.

```
\cs_new_protected:Nn \__enumext_before_list_viii:
  {
    \__enumext_vspace_above_viii:
    \__enumext_before_args_exec_viii:
    \__enumext_start_mini_viii:
  }
```

(*End of definition for* __enumext_before_list_viii:.)

__enumext_after_list_viii:

The function __enumext_after_list_viii: first calls the function __enumext_stop_mini_viii:, then apply the {⟨*code*⟩} handled by the after key together with the *vertical space* handled by the below key if they are present.

```
\cs_new_protected:Nn \__enumext_after_list_viii:
  {
    \__enumext_stop_mini_viii:
    \__enumext_after_stop_list_viii:
    \__enumext_vspace_below_viii:
  }
```

(*End of definition for* __enumext_after_list_viii:.)

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13.49.1 The command \item in keyans*

The idea here is to make the \item command behave in the same way as in the keyans environment with the difference of the *optional argument* (⟨*number*⟩) which works in the same way as in the enumext* environment.

In simple terms, the goal is to store the ⟨*label*⟩ next to the [⟨*content*⟩] if it is present in the *sequence* and *prop list* defined by save-ans key for \item*, \item*[⟨*content*⟩], \item(⟨*number*⟩)* and \item(⟨*number*⟩)*[⟨*content*⟩] commands.

__enumext_first_item_tmp_viii:

The __enumext_first_item_tmp_viii: function will remove horizontal space equal to \labelwidth plus \labelsep to the left of the *"first"* \item in the environment at the point of execution of this function, where it is equal to the __enumext_stop_item_tmp_viii: function inside the environment body definition.

```
\cs_new_protected_nopar:Nn \__enumext_first_item_tmp_viii:
  {
    \skip_horizontal:n
      {
        -\l__enumext_labelwidth_viii_dim - \l__enumext_labelsep_viii_dim
      }
    \ignorespaces
  }
```

(*End of definition for* __enumext_first_item_tmp_viii:.)

__enumext_start_item_tmp_viii:
__enumext_item_peek_args_viii:
__enumext_joined_item_viii:w
__enumext_standard_item_viii:w

First the function __enumext_stop_item_tmp_viii: is called, which is redefined later, then the value of \l__enumext_item_column_pos_viii_int, which counts the items by rows, and the value of \g__enumext_item_count_all_viii_int, which counts the total of items in the environment, are incremented. After that the function __enumext_item_peek_args_viii: is called, which handles the arguments passed to \item.

```
\cs_new_protected_nopar:Nn \__enumext_start_item_tmp_viii:
  {
    \__enumext_stop_item_tmp_viii:
    \int_incr:N \l__enumext_item_column_pos_viii_int
    \int_gincr:N \g__enumext_item_count_all_viii_int
    \__enumext_item_peek_args_viii:
  }
```

The function __enumext_item_peek_args_viii: handles the \item(⟨*number*⟩). It looks for the argument "(": if it is present, it calls the function __enumext_joined_item_viii:w (⟨*number*⟩), which is in charge of joining the items in the same row; if it is not present, it sets the default value (1).

```
\cs_new_protected:Nn \__enumext_item_peek_args_viii:
  {
    \peek_meaning:NTF (
      { \__enumext_joined_item_viii:w }
      { \__enumext_joined_item_viii:w (1) }
  }
```

The function __enumext_joined_item_viii:w first sets the *width* of the box that stores the content passed to \item by calling __enumext_starred_joined_item_viii:n. Then it looks for the argument "*": if it is present, it calls __enumext_starred_item_viii:w, otherwise __enumext_standard_item_viii:w.

```
\cs_new_protected:Npn \__enumext_joined_item_viii:w (#1)
  {
    \__enumext_starred_joined_item_viii:n {#1}
    \peek_meaning_remove:NTF *
      { \__enumext_starred_item_viii:w }
      { \__enumext_standard_item_viii:w }
  }
```

The function __enumext_standard_item_viii:w will first look for the argument '[', if present it will set the state of the variable \l__enumext_wrap_label_viii_bool equal to the state of the variable \l__enumext_wrap_label_opt_viii_bool handled by the key wrap-label* and finally execute the *non-enumerated* version \item[⟨*custom*⟩] by means of the function __enumext_start_item_viii:w; otherwise it sets the value of the variable \l__enumext_wrap_label_viii_bool handled by the wrap-label key to true and set the switch \if@noitemarg to true to execute the enumerated version of \item by means of the function __enumext_start_item_viii:w [\l__enumext_label_viii_tl].

```
\cs_new_protected:Npn \__enumext_standard_item_viii:w
  {
    \bool_set_false:N \l__enumext_item_starred_viii_bool
    \bool_set_false:N \l__enumext_item_wrap_key_bool
```

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```
    \peek_meaning:NTF [
      {
        \bool_set_eq:NN \l__enumext_wrap_label_viii_bool
          \l__enumext_wrap_label_opt_viii_bool
        \__enumext_start_item_viii:w
      }
      {
        \bool_set_true:N \l__enumext_wrap_label_viii_bool
        \legacy_if_set_true:n { @noitemarg }
        \__enumext_start_item_viii:w [ \l__enumext_label_viii_tl ] \ignorespaces
      }
  }
```

(*End of definition for* `\__enumext_start_item_tmp_viii:` *and others.*)

`\__enumext_starred_item_viii:w`
`\__enumext_starred_item_viii_aux_i:w`
`\__enumext_starred_item_viii_aux_ii:w`
`\__enumext_keyans_starred_item_star:`

The function `\__enumext_starred_item_viii:w` together with the specified auxiliary functions `aux_i:w` and `aux_ii:w` execute `\item*` and `\item*[`⟨*content*⟩`]`.

```
\cs_new_protected:Npn \__enumext_starred_item_viii:w
  {
    \bool_set_true:N \l__enumext_item_starred_viii_bool
    \bool_set_true:N \l__enumext_item_wrap_key_bool
    \bool_set_true:N \l__enumext_wrap_label_viii_bool
    \peek_meaning:NTF [
      { \__enumext_starred_item_viii_aux_i:w }
      { \__enumext_starred_item_viii_aux_ii:w }
  }
```

The function `\__enumext_starred_item_viii_aux_i:w` will save the *optional argument* to `\item*` in `\l__enumext_store_current_opt_arg_tl` and will save this argument along with the spacing set by the key `save-sep` in variable `\l__enumext_store_current_label_tl` if present, then call the function `\__enumext_starred_item_viii_aux_ii:w`.

```
\cs_new_protected:Npn \__enumext_starred_item_viii_aux_i:w [#1]
  {
    \tl_clear:N \l__enumext_store_current_label_tl
    \tl_if_novalue:nF {#1}
      {
        \tl_if_empty:NF \l__enumext_store_keyans_item_opt_sep_viii_tl
          {
            \tl_put_right:NV \l__enumext_store_current_label_tl
              \l__enumext_store_keyans_item_opt_sep_viii_tl
            \tl_put_right:Nn \l__enumext_store_current_label_tl {#1}
          }
        \tl_set:Nn \l__enumext_store_current_opt_arg_tl {#1}
      }
    \__enumext_starred_item_viii_aux_ii:w
  }
\cs_new_protected:Npn \__enumext_starred_item_viii_aux_ii:w
  {
    \legacy_if_set_true:n { @noitemarg }
    \__enumext_start_item_viii:w [ \l__enumext_label_viii_tl ] \ignorespaces
  }
```

The function `\__enumext_keyans_starred_item_star:` will be in charge of storing the current ⟨*label*⟩ for `\item*` followed by the `[`⟨*content*⟩`]` for `\item*[`⟨*content*⟩`]` if present in the *sequence* and *prop list* set by the `save-ans` key. In this same function the keys `show-ans`, `show-pos`, `mark-sep` and `save-ref` are implemented.

```
\cs_new_protected:Nn \__enumext_keyans_starred_item_star:
  {
    \tl_put_left:Ne \l__enumext_store_current_label_tl { \l__enumext_label_viii_tl }
    \__enumext_store_addto_prop:V \l__enumext_store_current_label_tl
    \__enumext_keyans_store_ref:
    \tl_put_left:Nn \l__enumext_store_current_label_tl { \item }
    \__enumext_keyans_addto_seq_link:
    \int_gincr:N \g__enumext_check_starred_cmd_int
    \dim_compare:nNnT { \l__enumext_mark_sym_sep_viii_dim } = { \c_zero_dim }
      {
        \dim_set:Nn \l__enumext_mark_sym_sep_viii_dim { \l__enumext_labelsep_viii_dim }
      }
    \bool_if:NT \l__enumext_show_answer_bool
```

```
      {
        \tl_set_eq:NN \l__enumext_mark_answer_sym_tl \l__enumext_mark_answer_sym_viii_tl
        \str_set_eq:NN \l__enumext_mark_position_str \l__enumext_mark_position_viii_str
        \__enumext_print_keyans_box:NN
          \l__enumext_labelwidth_viii_dim \l__enumext_mark_sym_sep_viii_dim
      }
    \bool_if:NT \l__enumext_show_position_bool
      {
        \tl_set:Ne \l__enumext_mark_answer_sym_tl
          {
            \group_begin:
              \exp_not:N \normalfont
              \exp_not:N \footnotesize [ \int_eval:n
                {
                  \prop_count:c { g__enumext_ \l__enumext_store_name_tl _prop }
                }
              ]
            \group_end:
          }
        \str_set_eq:NN \l__enumext_mark_position_str \l__enumext_mark_position_viii_str
        \__enumext_print_keyans_box:NN
          \l__enumext_labelwidth_viii_dim \l__enumext_mark_sym_sep_viii_dim
      }
  }
```

(*End of definition for* `\__enumext_starred_item_viii:w` *and others.*)

`\__enumext_keyans_wrapper_label_viii:n`
`\__enumext_fake_make_label_viii:n`
`\__enumext_wrapper_label_viii:n`

The implementation at this point is very similar to that of the `enumext*` environment.

```
\cs_new_protected:Nn \__enumext_keyans_wrapper_label_viii:n
  {
    \bool_lazy_all:nT
      {
        { \bool_if_p:N \l__enumext_wrap_label_viii_bool         }
        { \bool_if_p:N \l__enumext_show_answer_bool             }
        { \bool_if_p:N \l__enumext_item_wrap_key_bool           }
        { \cs_if_exist_p:N \__enumext_keyans_wrapper_item_viii:n }
      }
      {
        \cs_set_eq:NN
          \__enumext_wrapper_label_viii:n \__enumext_keyans_wrapper_item_viii:n
      }
    \bool_if:NTF \l__enumext_wrap_label_viii_bool
      {
        \__enumext_wrapper_label_viii:n {#1}
      }
      {#1}
  }
\cs_new_protected_nopar:Nn \__enumext_fake_make_label_viii:n
  {
    \legacy_if:nT { @noitemarg }
      {
        \legacy_if_set_false:n { @noitemarg }
        \legacy_if:nT { @nmbrlist }
          {
            \IfDocumentMetadataT
              {
                \bool_if:NT \l__enumext_hyperref_bool
                  {
                    \legacy_if_set_true:n { @hyper@item }
                  }
              }
            \refstepcounter{enumXviii}
          }
      }
    \bool_if:NT \l__enumext_item_starred_viii_bool
      {
        \__enumext_keyans_starred_item_star:
      }
    \makebox[ \l__enumext_labelwidth_viii_dim ][ \l__enumext_align_label_viii_str ]
      {
        \tl_use:N \l__enumext_label_font_style_viii_tl
```

```
      \__enumext_keyans_wrapper_label_viii:n {#1}
    }
  \skip_horizontal:N \l__enumext_labelsep_viii_dim \ignorespaces
}
```

(*End of definition for* `\__enumext_keyans_wrapper_label_viii:n`, `\__enumext_fake_make_label_viii:n`, *and* `\__enumext_wrapper_label_viii:n`.)

13.49.2 Real definition of `\item` in keyans*

`\__enumext_start_item_viii:w`
`\__enumext_start_item_box_viii:w`
`\__enumext_stop_item_viii:`

The implementation at this point is very similar to that of the enumext* environment. The function `\__enumext_start_item_viii:w` chooses between `\__enumext_start_item_break_viii:n` and `\__enumext_start_item_box_viii:w` in the same way.

```
\cs_new_protected_nopar:Npn \__enumext_start_item_viii:w [#1]
  {
    \bool_lazy_and:nnTF
      { \l__enumext_item_break_viii_bool }
      {
        \int_compare_p:nNn
          { \l__enumext_joined_item_viii_int } = { \l__enumext_columns_viii_int }
      }
      { \__enumext_start_item_break_viii:n {#1} }
      { \__enumext_start_item_box_viii:w [#1] }
  }
\cs_new_protected_nopar:Npn \__enumext_start_item_box_viii:w [#1]
  {
    \cs_set_eq:NN \__enumext_stop_item_tmp_viii: \__enumext_stop_item_viii:
    \hbox_set_to_wd:Nnw \l__enumext_item_text_viii_box
      {
        \l__enumext_joined_width_viii_dim
        + \l__enumext_labelwidth_viii_dim
        + \l__enumext_labelsep_viii_dim
      }
      \__enumext_renew_footnote_starred:
      \__enumext_start_list_tag:n {keyans*}
      \__enumext_fake_make_label_viii:n {#1}
      \__enumext_stop_start_list_tag:
      \__enumext_minipage:w [ t ]{ \l__enumext_joined_width_viii_dim }
        \__enumext_nested_reset:
        \dim_set_eq:NN \parindent \l__enumext_listparindent_viii_dim
        \skip_set_eq:NN \parskip \l__enumext_parsep_viii_skip
        \__enumext_unskip_unkern:
        \__enumext_unskip_unkern:
        \skip_horizontal:n { -\l__enumext_listparindent_viii_dim } \ignorespaces
        \tl_use:N \l__enumext_fake_item_indent_viii_tl
        \bool_if:NT \l__enumext_item_starred_viii_bool
          {
            \__enumext_keyans_show_item_opt_viii:
          }
        \tl_use:N \l__enumext_after_list_args_viii_tl
  }
\cs_new_protected_nopar:Nn \__enumext_stop_item_viii:
  {
     \__enumext_endminipage:
    \__enumext_stop_list_tag:n {keyans*}
    \hbox_set_end:
    \int_set:Nn \hbadness { 10000 }
    \box_use_drop:N \l__enumext_item_text_viii_box
    \int_compare:nNnTF
      { \l__enumext_item_column_pos_viii_int } = { \l__enumext_columns_viii_int }
      {
        \par\noindent
        \int_zero:N \l__enumext_item_column_pos_viii_int
      }
      {
        \skip_horizontal:N \l__enumext_columns_sep_viii_dim
      }
  }
```

(*End of definition for* `\__enumext_start_item_viii:w`, `\__enumext_start_item_box_viii:w`, *and* `\__enumext_stop_item_viii:`.)

__enumext_start_item_break_viii:n
__enumext_stop_item_break_viii:

For the keyans* environment the implementation is the same as __enumext_start_item_break_vii:n and __enumext_stop_item_break_vii:. The item option shown by \item* is placed at the beginning of the ⟨*content*⟩.

```
\cs_new_protected_nopar:Nn \__enumext_start_item_break_viii:n
  {
    \cs_set_eq:NN \__enumext_stop_item_tmp_viii: \__enumext_stop_item_break_viii:
    \group_begin:
      \dim_add:Nn \@totalleftmargin
        { \l__enumext_labelwidth_viii_dim + \l__enumext_labelsep_viii_dim }
      \dim_sub:Nn \linewidth
        { \l__enumext_labelwidth_viii_dim + \l__enumext_labelsep_viii_dim }
      \parshape \c_one_int \@totalleftmargin \linewidth
      \skip_horizontal:n
        { -\l__enumext_labelwidth_viii_dim - \l__enumext_labelsep_viii_dim }
      \__enumext_start_list_tag:n {keyans*}
      \__enumext_fake_make_label_viii:n {#1}
      \__enumext_nested_reset:
      \__enumext_stop_start_break_tag:
      \dim_set_eq:NN \parindent \l__enumext_listparindent_viii_dim
      \skip_set_eq:NN \parskip \l__enumext_parsep_viii_skip
      \tl_use:N \l__enumext_fake_item_indent_viii_tl
      \bool_if:NT \l__enumext_item_starred_viii_bool
        { \__enumext_keyans_show_item_opt_viii: }
      \tl_use:N \l__enumext_after_list_args_viii_tl
  }
\cs_new_protected_nopar:Nn \__enumext_stop_item_break_viii:
  {
    \__enumext_stop_item_break_tag:n {keyans*}
    \par
    \group_end:
    \int_zero:N \l__enumext_item_column_pos_viii_int
    \noindent
  }
```

(*End of definition for* __enumext_start_item_break_viii:n *and* __enumext_stop_item_break_viii:.)

__enumext_remove_extra_parsep_viii:

The implementation at this point is very similar to that of the enumext* environment.

```
\cs_new_protected:Nn \__enumext_remove_extra_parsep_viii:
  {
    \int_compare:nNnT
      {
        \int_mod:nn
          { \g__enumext_item_count_all_viii_int }
          { \l__enumext_columns_viii_int }
      }
      =
      { 0 }
      {
        \para_end:
        \skip_vertical:n { -\l__enumext_itemsep_viii_skip }
        \skip_vertical:N \c_zero_skip
        \int_gzero:N \g__enumext_item_count_all_viii_int
      }
  }
```

(*End of definition for* __enumext_remove_extra_parsep_viii:.)

13.50 The command \getkeyans

13.50.1 Definition of error messages for \getkeyans

missing-colon

Message used by \getkeyans command.

```
\msg_new:nnnn { enumext } { missing-colon }
  {
    The~argument~'#1'~has~no~colon~\msg_line_context:.
  }
  {
    The~argument~of~'\token_to_str:N \getkeyans'~must~have~the~form~
    'store~name:position'.
  }
```

(*End of definition for* missing-colon.)

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13.50.2 Internal functions for \getkeyans

__enumext_getkeyans_aux:n
__enumext_getkeyans_aux:e
__enumext_getkeyans:nn

The internal function __enumext_getkeyans_aux:n is in charge of *splitting* the *mandatory argument* using ":". If ":" is omitted it will return an error.

```
\cs_new_protected:Nn \__enumext_getkeyans_aux:n
  {
    \str_if_in:nnTF {#1} { : }
      {
        \use:e
          {
            \cs_set:Npn \exp_not:N \__enumext_tmp:w ##1 \c_colon_str ##2 \scan_stop:
              { {##1} {##2} }
          }
        \exp_after:w \__enumext_getkeyans:nn \__enumext_tmp:w #1 \scan_stop:
      }
      { \msg_error:nnn { enumext } { missing-colon } {#1} }
  }
\cs_generate_variant:Nn \__enumext_getkeyans_aux:n { e }
```

The internal function __enumext_getkeyans:nn will check for the existence of the *prop list*, if it does not exist it will return an error message, then it will fetch the content specified by the *second argument* from *prop list*.

```
\cs_new_protected:Nn \__enumext_getkeyans:nn
  {
    \prop_if_exist:cTF { g__enumext_ #1 _prop }
      {
        \prop_item:cn { g__enumext_ #1 _prop }{#2}
      }
      {
        \msg_error:nnn { enumext } { undefined-storage-anskey } {#1}
      }
  }
```

(*End of definition for* __enumext_getkeyans_aux:n *and* __enumext_getkeyans:nn.)

\getkeyans

The \getkeyans command takes a *mandatory argument* of the form {⟨*store name* : *position*⟩} in '#1'. The argument is expanded and converted to a string before it is processed. Retrieve a *"single content"* stored by \anskey, \anspic* and \item* and anskey* from *prop list* defined by save-ans key.

```
\NewDocumentCommand \getkeyans { m }
  {
    \__enumext_getkeyans_aux:e
      { \tl_to_str:e { \text_expand:n {#1} } }
  }
```

(*End of definition for* \getkeyans. *This function is documented on page* 21.)

13.51 The command \printkeyans

The \printkeyans command prints *"all stored content"* in the *sequence* defined by the save-ans key.

13.51.1 Definition of variables for \printkeyans

\c__enumext_print_envs_clist
\c__enumext_default_vars_clist
\c__enumext_default_label_X_tl

The command \printkeyans must not depend on the values that \setenumext sets for the environments, so the default values of the package are saved when it is loaded. The constant \c__enumext_print_envs_clist lists the environments that \printkeyans can open and the constant \c__enumext_default_vars_clist lists, as pairs ⟨*name*⟩⟨*type*⟩, the local variables of each environment whose default value is saved. Each value is saved in a global variable with the same name as the local one, but starting with \g__enumext_default_ instead of \l__enumext_, for example \g__enumext_default_labelsep_ii_dim for \l__enumext_labelsep_ii_dim. The default ⟨*label*⟩ is saved by the label key in \c__enumext_default_label_X_tl.

```
\clist_const:Nn \c__enumext_print_envs_clist
  {
    {level-1}{i}, {level-2}{ii}, {level-3}{iii}, {level-4}{iv}, {enumext*}{vii}
  }
\clist_const:Nn \c__enumext_default_vars_clist
  {
    {labelsep}{dim}, {labelwidth}{dim}, {fake_item_indent}{dim},
    {listoffset}{dim}, {rightmargin}{dim}, {listparindent}{dim},
    {leftmargin_tmp}{dim}, {leftmargin_tmp}{bool}, {columns_sep}{dim},
```

```
    {minipage_hsep}{dim}, {topsep}{skip}, {partopsep}{skip}, {parsep}{skip},
    {itemsep}{skip}, {columns}{int}, {start}{int}, {beginparpenalty}{int},
    {itempenalty}{int}, {endparpenalty}{int}, {label_fill_left}{tl},
    {label_fill_right}{tl}, {align_label_pos}{str}, {label_font_style}{tl},
    {after_list_args}{tl}, {wrap_label_opt}{bool}, {item_break}{bool}
  }
```

(*End of definition for* `\c__enumext_print_envs_clist`, `\c__enumext_default_vars_clist`, *and* `\c__enumext_default_label_X_tl`.)

`\l__enumext_print_keyans_starred_tl` The token list `\l__enumext_print_keyans_starred_tl` is used by the command `\printkeyans` (§13.51).

```
\tl_new:N \l__enumext_print_keyans_starred_tl
```

(*End of definition for* `\l__enumext_print_keyans_starred_tl`.)

13.51.2 Definition of error messages for `\printkeyans`

`print-starred` Messages used by `\printkeyans*` command.

```
\msg_new:nnnn { enumext } { print-starred }
  {
    '\token_to_str:N \printkeyans*':~The~sequence~'#1'~already~contains~
    #2~environment~\msg_line_context:.
  }
  {
    '\token_to_str:N \printkeyans*'~opens~'enumext*';~use~
    '\token_to_str:N \printkeyans'~without~the~star.
  }
```

(*End of definition for* `print-starred`.)

13.51.3 Definition of keys for `\printkeyans`

`print*` `print-*` `print-1` `print-2` `print-3` `print-4` First a set of ⟨*filtered keys*⟩ is defined, with which the options of the different nesting levels are controlled for the environments `enumext` and `enumext*` by storing their values in the list of tokens `\l__enumext_print_keyans_X_tl`.

The default values only contain what the printed content changes with respect to the default values of the package: `nosep`, `first` and `font`, plus `columns` for the *"first level"*. The remaining values are restored by the function `\__enumext_default_restore:` before these ⟨*keys*⟩ are run (§13.51).

The variable `\l__enumext_print_keyans_starred_tl` will have the default ⟨*keys*⟩ for `\printkeyans*` and will be set by `\setenumext[`⟨*print**⟩`]` and the variable `\l__enumext_print_keyans_vii_tl` will have the default keys for the environment `enumext*` nested within the *sequence* and will be set by `\setenumext[`⟨*print* ,***⟩`]`, the rest of the variables will be for the environment `enumext` and will be set by `\setenumext[`⟨*print* , *level*⟩`]`.

```
\keys_define:nn  { enumext / print }
  {
    print*  .code:n =
      {
        \keys_precompile:neN { enumext / enumext* }
          { \__enumext_filter_save_key:n {#1} }
          \l__enumext_print_keyans_starred_tl
      }, % starred cmd
    print*  .initial:n =
      {
        nosep,
        columns = 2,
        first   = \small,
        font    = \small
      },
    print-1 .code:n =
      {
        \keys_precompile:neN { enumext / level-1 }
          { \__enumext_filter_save_key:n {#1} }
          \l__enumext_print_keyans_i_tl
      },
    print-1 .initial:n =
      {
        nosep,
        columns = 2,
        first   = \small,
```

```
6357          font    = \small
6358        },
6359      print-2 .code:n =
6360        {
6361          \keys_precompile:neN { enumext / level-2 }
6362            { \__enumext_filter_save_key:n {#1} }
6363            \l__enumext_print_keyans_ii_tl
6364        },
6365      print-2 .initial:n =
6366        {
6367          nosep,
6368          first = \small,
6369          font  = \small
6370        },
6371      print-3 .code:n =
6372        {
6373          \keys_precompile:neN { enumext / level-3 }
6374            { \__enumext_filter_save_key:n {#1} }
6375            \l__enumext_print_keyans_iii_tl
6376        },
6377      print-3 .initial:n =
6378        {
6379          nosep,
6380          first = \small,
6381          font  = \small
6382        },
6383      print-4 .code:n =
6384        {
6385          \keys_precompile:neN { enumext / level-4 }
6386            { \__enumext_filter_save_key:n {#1} }
6387            \l__enumext_print_keyans_iv_tl
6388        },
6389      print-4 .initial:n =
6390        {
6391          nosep,
6392          first = \small,
6393          font  = \small
6394        },
6395      print-* .code:n =
6396        {
6397          \keys_precompile:neN { enumext / enumext* }
6398            { \__enumext_filter_save_key:n {#1} }
6399            \l__enumext_print_keyans_vii_tl
6400        }, % starred nested
6401      print-* .initial:n =
6402        {
6403          nosep,
6404          first = \small,
6405          font  = \small
6406        },
6407    }
```

(*End of definition for* `print*` *and others.*)

13.51.4 Internal functions for `\printkeyans`

`\__enumext_default_save:nnn`
`\__enumext_default_restore:nnn`
`\__enumext_default_save_env:nn`
`\__enumext_default_restore_env:nn`
`\__enumext_default_restore:`

The function `\__enumext_default_save:nnn` saves the value of a local variable, if it exists, in the global variable with the same name that starts with `\g__enumext_default_`, and the function `\__enumext_default_restore:nnn` copies it back.

```
6408 \cs_new_protected:Nn \__enumext_default_save:nnn
6409   {
6410     \cs_if_exist:cT { l__enumext_ #1 _ #3 _ #2 }
6411       {
6412         \use:c { #2 _new:c } { g__enumext_default_ #1 _ #3 _ #2 }
6413         \use:c { #2 _gset_eq:cc }
6414           { g__enumext_default_ #1 _ #3 _ #2 } { l__enumext_ #1 _ #3 _ #2 }
6415       }
6416   }
6417 \cs_new_protected:Nn \__enumext_default_restore:nnn
6418   {
6419     \cs_if_exist:cT { g__enumext_default_ #1 _ #3 _ #2 }
```

```
      {
        \use:c { #2 _set_eq:cc }
          { l__enumext_ #1 _ #3 _ #2 } { g__enumext_default_ #1 _ #3 _ #2 }
      }
  }
```

The function __enumext_default_save_env:nn saves, for one environment, all the variables of \c__enumext_default_vars_clist together with the function of the wrap-label key. The function __enumext_default_restore_env:nn restores them and runs the label key with the saved ⟨*label*⟩, since this key also defines the counter style and the width of the label.

```
\cs_new_protected:Nn \__enumext_default_save_env:nn
  {
    \clist_map_inline:Nn \c__enumext_default_vars_clist
      { \__enumext_default_save:nnn ##1 {#2} }
    \cs_gset_eq:cc { __enumext_default_wrapper_label_ #2 :n }
      { __enumext_wrapper_label_ #2 :n }
  }
\cs_new_protected:Nn \__enumext_default_restore_env:nn
  {
    \clist_map_inline:Nn \c__enumext_default_vars_clist
      { \__enumext_default_restore:nnn ##1 {#2} }
    \cs_set_eq:cc { __enumext_wrapper_label_ #2 :n }
      { __enumext_default_wrapper_label_ #2 :n }
    \keys_set:ne { enumext / #1 }
      { label = { \exp_not:v { c__enumext_default_label_ #2 _tl } } }
  }
```

Finally the function __enumext_default_restore: restores, for all the environments, the values saved when the package was loaded.

```
\cs_new_protected:Nn \__enumext_default_restore:
  {
    \clist_map_inline:Nn \c__enumext_print_envs_clist
      { \__enumext_default_restore_env:nn ##1 }
  }
\clist_map_inline:Nn \c__enumext_print_envs_clist
  { \__enumext_default_save_env:nn #1 }
```

(*End of definition for* __enumext_default_save:nnn *and others.*)

__enumext_printkeyans:nnn

The internal function __enumext_printkeyans:nnn will check for the existence of the *sequence*, if it does not exist it will return an error message, then it will check if not empty.

```
\cs_new_protected:Nn \__enumext_printkeyans:nnn
  {
    \seq_if_exist:cTF { g__enumext_ #3 _seq }
      {
        \seq_if_empty:cF { g__enumext_ #3 _seq }
          {
```

If the *starred argument* '*' is present, it checks that the environment enumext* is not saved in the *sequence*, then executes the variable \l__enumext_print_keyans_starred_tl that contains the default ⟨*keys*⟩ for the environment enumext*, sets \l__enumext_base_line_fix_bool and \l__enumext_print_keyans_star_bool to true for *baseline correction*, opens the enumext* environment passing the *optional argument* and maps the *sequence*, then sets \l__enumext_base_line_fix_bool and \l__enumext_print_keyans_star_bool to false.

```
            \bool_if:nTF {#1}
              {
                \seq_if_in:cnTF { g__enumext_ #3 _seq } { \end{enumext*} }
                  {
                    \msg_error:nnnn { enumext } { print-starred } {#3}
                      { enumext* }
                  }
                  {
                    \tl_use:N \l__enumext_print_keyans_starred_tl
                    \bool_set_true:N \l__enumext_base_line_fix_bool
                    \bool_set_true:N \l__enumext_print_keyans_star_bool
                    \begin{enumext*}[#2]
                      \seq_map_inline:cn { g__enumext_ #3 _seq } {##1}
                    \end{enumext*}
                    \bool_set_false:N \l__enumext_base_line_fix_bool
```

```
                    \bool_set_false:N \l__enumext_print_keyans_star_bool
                  }
              }
```

Otherwise it will open the environment `enumext` passing the *optional argument* to the *"first level"* then map the *sequence*.

```
              {
                \begin{enumext}[#2]
                  \seq_map_inline:cn { g__enumext_ #3 _seq } {##1}
                \end{enumext}
              }
          }
      }
      {
        \msg_error:nnn { enumext } { undefined-storage-anskey } {#3}
      }
  }
```

(*End of definition for* `\__enumext_printkeyans:nnn`.)

`\printkeyans` The command accepts a *starred argument* '`*`' in '`#1`', an optional `[`⟨*key = val*⟩`]` in '`#2`' and a mandatory `{`⟨*store name*⟩`}` in '`#3`'. Create a user command to print *"all stored content"* in *sequence* for `\anskey`, `anskey*`, `\item*` and `\anspic*`. Within a group the default values saved when the package was loaded are restored, then the *"precompiled keys"* are run and finally the stored content is printed.

```
\NewDocumentCommand \printkeyans { s O{} m }
  {
    \group_begin:
      \__enumext_default_restore:
      \bool_set_true:N \l__enumext_print_keyans_cmd_bool
      \tl_use:N \l__enumext_print_keyans_i_tl
      \tl_use:N \l__enumext_print_keyans_ii_tl
      \tl_use:N \l__enumext_print_keyans_iii_tl
      \tl_use:N \l__enumext_print_keyans_iv_tl
      \tl_use:N \l__enumext_print_keyans_vii_tl
      \__enumext_printkeyans:nnn {#1} {#2} {#3}
      \bool_set_false:N \l__enumext_print_keyans_cmd_bool
    \group_end:
  }
```

(*End of definition for* `\printkeyans`. *This function is documented on page* 21.)

The reason for storing ⟨*keys*⟩ in token lists using `\keys_precompile:neN` is because the keys are set via `\setenumext` but are later executed by running the command `\printkeyans` and they are not handled directly by its *optional argument*, except those related to the *first* opening level.

13.52 The command `\setenumext`

The command `\setenumext` is in charge of managing the ⟨*keys*⟩ passed to all environments and to the `\printkeyans` command. Precautions must be taken with the `enumext*` and `enumext` environments so as not to capture ⟨*keys*⟩ that cause problems.

13.52.1 Definition of variables for `\setenumext`

`\l__enumext_setkey_tmpa_tl` `\l__enumext_setkey_tmpb_tl` `\l__enumext_setkey_tmpa_int` `\l__enumext_setkey_tmpa_seq` `\l__enumext_setkey_tmpb_seq`

Internal variables used by the command `\setenumext` (§13.52).

```
\tl_new:N  \l__enumext_setkey_tmpa_tl
\tl_new:N  \l__enumext_setkey_tmpb_tl
\int_new:N \l__enumext_setkey_tmpa_int
\seq_new:N \l__enumext_setkey_tmpa_seq
\seq_new:N \l__enumext_setkey_tmpb_seq
```

(*End of definition for* `\l__enumext_setkey_tmpa_tl` *and others.*)

13.52.2 Definition of error messages for `\setenumext`

`invalid-level` `unknown-key-family`

Messages used by the `\setenumext` command.

```
\msg_new:nnnn { enumext } { invalid-level }
  {
    The~level~'#1'~is~not~valid~\msg_line_context:.
  }
  {
```

```
6507      The~optional~argument~must~be~a~family~followed~by~the~levels~
6508      1,~2,~3,~4~or~'*',~for~example~'print,1'.
6509    }
6510  \msg_new:nnnn { enumext } { unknown-key-family }
6511    {
6512      Unknown~key~family~'\l_keys_key_str'~for~enumext~\msg_line_context:.
6513    }
6514    {
6515      The~first~element~of~the~optional~argument~must~be~
6516      'enumext',~'enumext*',~'keyans',~'keyans*'~or~'print'.
6517    }
```

(*End of definition for* `invalid-level` *and* `unknown-key-family`.)

13.52.3 Definition of keys for `\setenumext`

enumext-1
enumext-2
enumext-3
enumext-4
enumext*
keyans
keyans*
print*
print-1
print-2
print-3
print-4
print-*
unknown

Now define a *"meta families"* of ⟨*keys*⟩ to access from `\setenumext`.

```
6518  \keys_define:nn { enumext / meta-families }
6519    {
6520      enumext-1 .code:n =
6521        {
6522          \keys_set:ne { enumext / level-1 }
6523            {
6524              \__enumext_filter_level:n {#1}
6525            }
6526        },
6527      enumext-2 .code:n =
6528        {
6529          \keys_set:ne { enumext / level-2 }
6530            {
6531              \__enumext_filter_level:n {#1}
6532            }
6533        },
6534      enumext-3 .code:n =
6535        {
6536          \keys_set:ne { enumext / level-3 }
6537            {
6538              \__enumext_filter_level:n {#1}
6539            }
6540        },
6541      enumext-4 .code:n =
6542        {
6543          \keys_set:ne { enumext / level-4 }
6544            {
6545              \__enumext_filter_level:n {#1}
6546            }
6547        },
6548      enumext*  .code:n =
6549        {
6550          \keys_set:ne { enumext / enumext* }
6551            {
6552              \__enumext_filter_level:n {#1}
6553            }
6554        },
6555      keyans    .meta:nn = { enumext / keyans } {#1},
6556      keyans*   .meta:nn = { enumext / keyans* } {#1},
6557      print*    .meta:nn = { enumext / print } { print* = {#1} },
6558      print-1   .meta:nn = { enumext / print } { print-1 = {#1} },
6559      print-2   .meta:nn = { enumext / print } { print-2 = {#1} },
6560      print-3   .meta:nn = { enumext / print } { print-3 = {#1} },
6561      print-4   .meta:nn = { enumext / print } { print-4 = {#1} },
6562      print-*   .meta:nn = { enumext / print } { print-* = {#1} },
6563      unknown   .code:n  = { \msg_error:nn { enumext } { unknown-key-family } },
6564    }
```

(*End of definition for* `enumext-1` *and others.*)

13.52.4 Internal functions for `\setenumext`

__enumext_filter_level:n
__enumext_filter_level_key:n
__enumext_filter_level_pair:nn

The function `\__enumext_filter_level:n` will be in charge of filtering the ⟨*keys*⟩ passed to the `enumext` and `enumext*` environments.

```
6565  \cs_new:Nn \__enumext_filter_level:n
```

```
  {
    \use:e
      {
        \keyval_parse:NNn
          \__enumext_filter_level_key:n
          \__enumext_filter_level_pair:nn {#1}
      }
  }
```

The function __enumext_filter_level_key:n will be responsible for filtering the ⟨*keys*⟩ that are passed *"without value"* by excluding the keys resume*, reset and reset* passed to the enumext and enumext* environments.

```
\cs_new:Nn \__enumext_filter_level_key:n
  {
    \str_case:nnF {#1}
      {
        { resume* } { } { reset } { } { reset* } { }
      }
      { , { \exp_not:n {#1} } }
  }
```

The function __enumext_filter_level_pair:nn will be responsible for filtering the ⟨*keys*⟩ that are passed *"with value"* by excluding the series, resume and save-ans keys passed to the enumext and enumext* environments.

```
\cs_new:Nn \__enumext_filter_level_pair:nn
  {
    \str_case:nnF {#1}
      {
        { series } { }  { save-ans } { } { resume } { }
      }
      { , { \exp_not:n {#1} } = { \exp_not:n {#2} } }
  }
```

(*End of definition for* __enumext_filter_level:n, __enumext_filter_level_key:n, *and* __enumext_filter_level_pair:nn.)

__enumext_set_parse:n
__enumext_set_error:n

Internal functions used by the \setenumext command.

```
\cs_new_protected:Nn \__enumext_set_parse:n
  {
    \tl_set:Ne \l__enumext_setkey_tmpb_tl { \tl_trim_spaces:n {#1} }
    \clist_map_inline:nn { 0, 1, 2, 3, 4, * } % <- max level
      { \tl_remove_all:Nn \l__enumext_setkey_tmpb_tl {##1} }
    \tl_if_empty:NTF \l__enumext_setkey_tmpb_tl
      {
        \seq_put_right:Ne \l__enumext_setkey_tmpa_seq
          { \tl_trim_spaces:n {#1} }
      }
      { \__enumext_set_error:n {#1} }
  }
\cs_new_protected:Nn \__enumext_set_error:n
  { \msg_error:nnn { enumext } { invalid-level } {#1} }
```

(*End of definition for* __enumext_set_parse:n *and* __enumext_set_error:n.)

\setenumext

Defines the user command \setenumext. It accepts an optional argument in '#1' that selects the environments and levels, with default value enumext,1, and a mandatory [⟨*key* = *val*⟩] argument in '#2'. The optional argument is split into the families to be modified and the ⟨*keys*⟩ are passed to each one of them.

```
\NewDocumentCommand \setenumext { O{enumext,1} +m }
  {
    \seq_clear:N \l__enumext_setkey_tmpa_seq
    \seq_set_from_clist:Nn \l__enumext_setkey_tmpb_seq {#1}
    \int_set:Nn \l__enumext_setkey_tmpa_int
      {
        \seq_count:N \l__enumext_setkey_tmpb_seq
      }
    \int_compare:nNnTF { \l__enumext_setkey_tmpa_int } > { 1 }
      {
        \seq_pop_left:NN \l__enumext_setkey_tmpb_seq \l__enumext_setkey_tmpa_tl
        \seq_map_function:NN \l__enumext_setkey_tmpb_seq \__enumext_set_parse:n
```

```
      \seq_set_map_e:NNn \l__enumext_setkey_tmpa_seq \l__enumext_setkey_tmpa_seq
        {
          \tl_use:N \l__enumext_setkey_tmpa_tl - ##1
        }
    }
    {
      \seq_put_right:Ne \l__enumext_setkey_tmpa_seq { \tl_trim_spaces:n {#1} }
    }
  \seq_map_inline:Nn \l__enumext_setkey_tmpa_seq
    {
      \keys_set:nn { enumext / meta-families } { ##1 = {#2} }
    }
}
```

(*End of definition for* `\setenumext`. *This function is documented on page* 7.)

13.53 The command `\setenumextmeta`

The command `\setenumextmeta` will be responsible for adding new *"meta-keys"* for the `enumext` and `enumext*` environments. The implementation code was given by Jonathan P. Spratte (`@Skillmon`) answer in Simplify syntax for command that adds `.meta` key to existing keys (l3keys).

13.53.1 Definition of variables for `\setenumextmeta`

`\l__enumext_meta_path_str` The string `\l__enumext_meta_path_str` is used by the `\setenumextmeta` command (§13.53).

```
\str_new:N \l__enumext_meta_path_str
```

(*End of definition for* `\l__enumext_meta_path_str`.)

13.53.2 Definition of error messages for `\setenumextmeta`

`already-defined` `prohibited-unknown` Messages used by `\setenumextmeta` command.

```
\msg_new:nnnn { enumext } { already-defined }
  {
    The~key~'#1'~is~already~defined~\msg_line_context:.
  }
  {
    Choose~another~name~for~the~meta~key.
  }
\msg_new:nnnn { enumext } { prohibited-unknown }
  {
    The~name~'unknown'~can't~be~chosen~for~a~meta~key~\msg_line_context:.
  }
  {
    'unknown'~is~reserved~by~the~package;~choose~another~name.
  }
```

(*End of definition for* `already-defined` *and* `prohibited-unknown`.)

13.53.3 Definition of keys for `\setenumextmeta`

`enumext` `enumext*` These ⟨*keys*⟩ are the selectors that can be passed in the *optional argument* of `\setenumextmeta` (§13.53) and `\setenumext` (§13.52). First, the selectors for each level, `1`, `2`, `3` and `4`, of type `.code:n` are created for *"all levels"* of the `enumext` environment.

```
\int_step_inline:nn { 4 }
  {
    \keys_define:nn { enumext }
      {
        #1 .code:n = { \str_set:Nn \l__enumext_meta_path_str { level-#1 } },
        #1 .value_forbidden:n = true,
      }
  }
```

And now the ⟨*keys*⟩ are defined for the environments using `.code:n` for the `enumext` environment and `.meta:n` for the `enumext*` environment.

```
\clist_map_inline:nn { enumext }
  {
    \keys_define:nn { enumext }
      {
        % ignored for now, might do something useful in the future
        #1  .code:n = { },
```

```
      #1  .value_forbidden:n = true,
      #1* .code:n = { \str_set:Nn \l__enumext_meta_path_str { #1* } },
      #1* .value_forbidden:n = true,
    }
  }
\keys_define:nn { enumext }
  {
    * .meta:n = enumext*,
    * .value_forbidden:n = true,
  }
```

(*End of definition for* `enumext` *and* `enumext*`.)

13.53.4 Internal functions for `\setenumextmeta`

`\__enumext_key_set_meta:nnn` `\__enumext_key_def_meta:nnn` `\__enumext_key_def_meta:Vnn`

The internal functions `\__enumext_key_set_meta:nnn` and `\__enumext_key_def_meta:nnn` will check the *optional argument* and create the *"meta-key"*.

```
\cs_new_protected:Npn \__enumext_key_set_meta:nnn #1
  {
    \keys_set:nn { enumext } {#1}
    \__enumext_key_def_meta:Vnn \l__enumext_meta_path_str
  }
\cs_new_protected:Nn \__enumext_key_def_meta:nnn
  {
    \bool_lazy_or:nnTF
      { \keys_if_exist_p:nn { enumext / #1} {#2} }
      { \keys_if_exist_p:nn { enumext / enumext* } {#2} }
      { \msg_error:nnn { enumext } { already-defined } {#2} }
      {
        \keys_define:nn { enumext / #1 }
          {
            #2 .meta:n = {#3},
            #2 .value_forbidden:n = true
          }
      }
  }
\cs_generate_variant:Nn \__enumext_key_def_meta:nnn { V }
```

(*End of definition for* `\__enumext_key_set_meta:nnn` *and* `\__enumext_key_def_meta:nnn`.)

`\setenumextmeta` Now the user command is created, taking care that unknown cannot be passed as an argument. It accepts a *starred argument* '`*`' in '`#1`', an optional argument in '`#2`' that selects the environments and levels, with default value `enumext,1`, the name of the new *"meta-key"* in '`#3`' and the ⟨*keys*⟩ it sets in '`#4`'. With the *starred argument* the *"meta-key"* is defined for the four levels of `enumext` and for `enumext*`.

```
\NewDocumentCommand \setenumextmeta { s O{enumext,1} m +m }
  {
    \str_if_eq:eeTF { \tl_trim_spaces:n {#3} } { unknown }
      { \msg_error:nn { enumext } { prohibited-unknown } }
      {
        \bool_if:nTF {#1}
          {
            \int_step_inline:nn { 4 }
              { \__enumext_key_set_meta:nnn { enumext, ##1 } {#3} {#4} }
            \__enumext_key_set_meta:nnn { enumext* } {#3} {#4}
          }
          { \__enumext_key_set_meta:nnn {#2} {#3} {#4} }
      }
  }
```

(*End of definition for* `\setenumextmeta`. *This function is documented on page* 7.)

13.54 The command `\foreachkeyans`

The command `\foreachkeyans` will execute a *loop* over the *prop list* and return its contents. The implementation code is adapted from the answer provided by Enrico Gregorio (`@egreg`) in Expand a `.cs` defined by key inside the function.

13.54.1 Definition of variables for \foreachkeyans

\l__enumext_foreach_print_seq
\l__enumext_foreach_name_prop_tl
\l__enumext_foreach_default_keys_tl

Internal variables used by the \foreachkeyans command (§13.54).

```
\seq_new:N \l__enumext_foreach_print_seq
\tl_new:N  \l__enumext_foreach_name_prop_tl
\tl_new:N  \l__enumext_foreach_default_keys_tl
```

(*End of definition for* `\l__enumext_foreach_print_seq`, `\l__enumext_foreach_name_prop_tl`, *and* `\l__enumext_foreach_default_keys_tl`.)

13.54.2 Definition of error messages for \foreachkeyans

for-key-unknown
for-key-value-unknown

Message used by unknown ⟨*keys*⟩ in \foreachkeyans.

```
\msg_new:nnnn { enumext } { for-key-unknown }
  {
    The~key~'#1'~is~unknown~by~'\token_to_str:N \foreachkeyans'~and~is~being~
    ignored~\msg_line_context:.
  }
  {
    The~command~'\token_to_str:N \foreachkeyans'~does~not~have~a~key~called~
    '#1'.~Check~that~you~have~spelled~the~key~name~correctly.
  }
\msg_new:nnnn { enumext } { for-key-value-unknown }
  {
    The~key~'#1=#2'~is~unknown~by~'\token_to_str:N \foreachkeyans'~and~is~
    being~ignored~\msg_line_context:.
  }
  {
    The~command~'\token_to_str:N \foreachkeyans'~does~not~have~a~key~called~
    '#1'.~Check~that~you~have~spelled~the~key~name~correctly.
  }
```

(*End of definition for* `for-key-unknown` *and* `for-key-value-unknown`.)

13.54.3 Definition of keys for \foreachkeyans

before
after
sep
start
step
stop
wrapper
unknown

A set of ⟨*keys*⟩ is defined for the command. The default values of these are saved in the variable \l__enumext_foreach_default_keys_tl to avoid the use of a group.

```
\keys_define:nn { enumext / foreach }
  {
    before  .tl_set:N = \l__enumext_foreach_before_tl,
    before  .value_required:n = true,
    after   .tl_set:N = \l__enumext_foreach_after_tl,
    after   .value_required:n = true,
    start   .int_set:N = \l__enumext_foreach_start_int,
    start   .value_required:n = true,
    stop    .int_set:N = \l__enumext_foreach_stop_int,
    stop    .value_required:n = true,
    step    .int_set:N = \l__enumext_foreach_step_int,
    step    .value_required:n = true,
    wrapper .cs_set_protected:Np = \__enumext_foreach_wrapper:n #1,
    wrapper .value_required:n = true,
    sep     .tl_set:N = \l__enumext_foreach_sep_tl,
    sep     .value_required:n = true,
    unknown .code:n = { \__enumext_parse_foreach_keys:n {#1} }
  }
\keys_precompile:nnN { enumext / foreach }
  {
    before={},after={},start=1,step=1,stop=0,wrapper=#1,sep={; }
  }
  \l__enumext_foreach_default_keys_tl
```

(*End of definition for* `before` *and others.*)

13.54.4 Internal functions for \foreachkeyans

__enumext_parse_foreach_keys:nn
__enumext_parse_foreach_keys:Vn
__enumext_parse_foreach_keys:n

Functions for handling unknown ⟨*keys*⟩.

```
\cs_new_protected:Nn \__enumext_parse_foreach_keys:nn
  {
    \tl_if_blank:nTF {#2}
      {
```

```
6750          \msg_error:nnn { enumext } { for-key-unknown } {#1}
6751        }
6752        {
6753          \msg_error:nnnn { enumext } { for-key-value-unknown } {#1} {#2}
6754        }
6755    }
6756  \cs_generate_variant:Nn \__enumext_parse_foreach_keys:nn { V }
6757  \cs_new_protected:Nn \__enumext_parse_foreach_keys:n
6758    {
6759      \__enumext_parse_foreach_keys:Vn \l_keys_key_str {#1}
6760    }
```

(*End of definition for* `\__enumext_parse_foreach_keys:nn` *and* `\__enumext_parse_foreach_keys:n`.)

`\__enumext_foreach_keyans:nn`
`\__enumext_foreach_add_body:n`

The internal functions `\__enumext_foreach_keyans:nn` and `\__enumext_foreach_add_body:n` will loop through the prop list and print the contents.

```
6761  \cs_new_protected:Nn \__enumext_foreach_keyans:nn
6762    {
6763      \tl_use:N \l__enumext_foreach_default_keys_tl
6764      \keys_set:nn { enumext / foreach } {#1}
6765      \tl_set:Nn \l__enumext_foreach_name_prop_tl {#2}
6766      \prop_if_exist:cF { g__enumext_ #2 _prop }
6767        {
6768          \msg_error:nnn { enumext } { undefined-storage-anskey } {#2}
6769        }
6770      \int_compare:nNnT { \l__enumext_foreach_stop_int } = { 0 }
6771        {
6772          \int_set:Nn \l__enumext_foreach_stop_int
6773            { \prop_count:c { g__enumext_ #2 _prop } }
6774        }
6775      \seq_clear:N \l__enumext_foreach_print_seq
6776      \int_step_function:nnnN
6777        { \l__enumext_foreach_start_int }
6778        { \l__enumext_foreach_step_int }
6779        { \l__enumext_foreach_stop_int }
6780        \__enumext_foreach_add_body:n
6781        \seq_use:NV \l__enumext_foreach_print_seq \l__enumext_foreach_sep_tl
6782    }
6783  \cs_new_protected:Nn \__enumext_foreach_add_body:n
6784    {
6785      \seq_put_right:Ne \l__enumext_foreach_print_seq
6786        {
6787          \exp_not:V \l__enumext_foreach_before_tl
6788          \__enumext_foreach_wrapper:n
6789            {
6790              \prop_item:cn { g__enumext_ \l__enumext_foreach_name_prop_tl _prop }{#1}
6791            }
6792          \exp_not:V \l__enumext_foreach_after_tl
6793        }
6794    }
```

(*End of definition for* `\__enumext_foreach_keyans:nn` *and* `\__enumext_foreach_add_body:n`.)

`\foreachkeyans`

The command accepts an optional `[`⟨*key = val*⟩`]` argument in '`#1`' and a mandatory `{`⟨*store name*⟩`}` in '`#2`', and runs the loop over the content stored in it.

```
6795  \NewDocumentCommand \foreachkeyans { +O{} m }
6796    {
6797      \__enumext_foreach_keyans:nn {#1} {#2}
6798    }
```

(*End of definition for* `\foreachkeyans`. *This function is documented on page* 21.)

13.55 General messages

Messages shared by several sections of the implementation; the messages used by only one command, key or environment are defined in its own section.

`package-load`
`package-not-load`

Messages used when checking the `multicol` package in §13.3 and the `hyperref` and `footnotehyper` packages in §13.7.

```
6799  \msg_new:nnn { enumext } { package-load }
```

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```
6800   {
6801     The~'#1'~package~is~already~loaded.
6802   }
6803 \msg_new:nnn { enumext } { package-not-load }
6804   {
6805     The~'#1'~package~will~be~loaded~as~a~dependency.
6806   }
```

(*End of definition for* `package-load` *and* `package-not-load`.)

`unknown-choice` Message used by the keys `align` in §13.13, `mark-pos` in §13.31 and `label-pos` in §13.46.3.

```
6807 \msg_new:nnnn { enumext } { unknown-choice }
6808   {
6809     Invalid~value~'#3'~for~key~'#1';~use~one~of:~#2~\msg_line_context:.
6810   }
6811   {
6812     Use~one~of~the~listed~values.
6813   }
```

(*End of definition for* `unknown-choice`.)

`command-wrong-place` Message used by the commands `\anskey` in §13.34 and `\anspic` in §13.46.4 when they are used in the wrong place.

```
6814 \msg_new:nnnn { enumext } { command-wrong-place }
6815   {
6816     Wrong~place~for~command~'\c_backslash_str #1'~\msg_line_context:.
6817   }
6818   {
6819     '\c_backslash_str #1'~works~outside~the~environment~'#2'.
6820   }
```

(*End of definition for* `command-wrong-place`.)

`undefined-storage-anskey` Message used by the commands `\getkeyans` in §13.50, `\printkeyans` in §13.51 and `\foreachkeyans` in §13.54 when the storage is not defined.

```
6821 \msg_new:nnnn { enumext } { undefined-storage-anskey }
6822   {
6823     Storage~named~'#1'~is~not~defined~\msg_line_context:.
6824   }
6825   {
6826     Store~content~first~with~the~key~'save-ans=#1'.
6827   }
```

(*End of definition for* `undefined-storage-anskey`.)

`missing-miniright` Message used by `enumext` in §13.43 and `keyans` in §13.44 when the key `mini-env` needs `\miniright` from §13.25.7.

```
6828 \msg_new:nnn { enumext } { missing-miniright }
6829   {
6830     Missing~'\token_to_str:N \miniright'~\msg_line_context:.\\
6831     The~key~'mini-env'~needs~'\token_to_str:N \miniright'.
6832   }
```

(*End of definition for* `missing-miniright`.)

`nested` Message used when an environment is nested in itself, raised by `enumext*` in §13.48 and `keyans*` in §13.49.

```
6833 \msg_new:nnnn { enumext } { nested }
6834   {
6835     The~environment~\l__enumext_envir_name_tl \c_space_tl can't~be~nested~
6836     \msg_line_context:.
6837   }
6838   {
6839     Starred~environments~are~horizontal~lists~and~can't~be~nested.
6840   }
```

(*End of definition for* `nested`.)

13.56 Finish package

Finish package implementation.

```
6841 \file_input_stop:
6842 ⟨/package⟩
```

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