The exesheet class and package

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1 Introduction

The `exesheet` package is designed for typesetting exercise or exam sheets. Additionally, the `exesheet` class loads the `schooldocs` package [1]. The latter makes adjustments to margins and titles, and defines various layout styles with specific headers and footers suitable for exercise sheets, among other uses. Refer to the documentation of the `schooldocs` package for more details. The `exesheet` class is built upon the `article` class and forwards any unknown options to it.

There are many other packages dedicated to exercise sheets. In section 6.3 we provide an overview of some of their functionalities. Most of them suggest encapsulating each exercise within an environment. In contrast, `exesheet` starts each exercise with \texttt{\texttt{\textbackslash exercise}}, which functions similarly to a subsection (with the same features) and is suitable for documents that primarily consist of exercises. The package also offers alternative ways to introduce exercises, which are more appropriate for shorter exercises.

Another distinctive feature of the `exesheet` package is its specific settings for enumeration lists, which are suitable for numbering questions or answers within an exercise.

For all exercises within the sheet, you can display only the questions, only the answers, or both, all while preserving their placement as they appear in the source file. This choice allows for great flexibility: you can create a correct version for all exercises collectively, or individual corrections per exercise, per part (subpart of exercise), per question, per sub-question.

The ability to hide questions or answers is found in many packages, but the main interest of `exesheet` is to be able to display or not a detailed scoring guide, along with correction instructions. This is very useful for grading papers with multiple graders. Furthermore `exesheet` can check the consistency of the scale.

Many settings can be customized, and various options are available to manage the output document. These options rely on the key-val mechanism: \texttt{key=value}. These options can be applied when calling the class or the package, e.g.

\texttt{\textbackslash documentclass[a4paper,11pt,output=answers,display=pts]{exesheet}}

or later using the command \texttt{\textbackslash exesheetset\{\texttt{(options)}\}}. In the example above, \texttt{a4paper,11pt} are options that are passed to the underlying `article` class.

\textit{In the current document, a frame is utilized to emphasize output examples.}

2 Titles

2.1 The \texttt{\texttt{\textbackslash exercise}} command

\texttt{\texttt{\textbackslash exercise}} The \texttt{\texttt{\textbackslash exercise\{\texttt{(opt)}\}}} command initiates an exercise with the title \texttt{Exercise}, typeset as a document subsection, followed by automatic numbering, unique to the entire document. The optional parameter \texttt{\texttt{(opt)}} is utilized to include additional text on the same title line, such as specifying a subject or a marking scheme. Thus, using \texttt{\texttt{\textbackslash exercise\{\texttt{(to begin)}\}}} results in:

\begin{exercise}
\textbf{Exercise 1 (to begin)}

Try this first command; easy!
\end{exercise}
To bring optional text closer to the exercise number, you can employ `\unskip` which removes any preceding space. Take a look at the following example, achieved with `\exercise[\unskip***] (difficult)`:  

**Exercise 2*** (difficult)**

Calculate 1 + 1.

The term “Exercise” is automatically translated into various languages\(^1\) depending on the language that is loaded (via `babel` or `polyglossia`). You can alter it by modifying `\exercisename`. A better approach is to use macros from the `translations` package by Clemens Niederberger\(^7\) (which allows dynamic language switching), e.g. `\DeclareTranslation{swedish}{exesheet-exercise}{"Ovning"}`.

This command combines `\exercisename` with the exercise number and can be redefined. For instance, if you want to include a period after the exercise number, you can redefine it as follows:

`\renewcommand{\labelexercise}{\exercisename~\theexercise.}`

If you wish to alter only the numbering style, you can redefine the `\theexercise` command based on the `exercise` counter.

This macro, which is initially empty, enables the definition of a specific style for exercise titles. In this document, we have set the following in the preamble:

`\renewcommand{\labelexercisestyle}{\rmfamily\color{black}}`\(^2\)

The starred version `\exercise*[⟨opt⟩]{⟨label⟩}` permits the selection of an alternative ⟨label⟩ for a specific exercise while omitting the numbering. For instance:

`\exercise*[⟨Fermat’s theorem⟩]{Problem}` results in:

**Problem (Fermat’s theorem)**

Prove that there are no positive integers \(x, y, z\) such that \(x^n + y^n = z^n\) for any integer \(n\) greater than 2.

### 2.2 The `\subpart` command

An exercise may consist of multiple parts, which can be created using the `\subpart[⟨opt⟩]` command. The part title is typeset similar to a sub-subsection.

**Exercise 3**

**Part A (preliminary)**

To begin, prepare your cup of tea.

**Part B**

Now you are ready to proceed with the current exercise.

---

\(^1\)Currently, translation is integrated into the package for the following languages: French, German, Spanish, Italian, and Portuguese.

\(^2\)In this document, real section and subsection titles have been highlighted by modifying their color and font (sans serif) using the `\allsectionsfont` macro from the `sectsty` package [10].
The following macros allow customization in the same manner as for \exercise.

\thesubpart
By default, subpart numbering employs letters: A, B, C, and so on. This numbering style can be modified using the \thesubpart command, which relies on the subpart counter. For example, you can redefine it as follows: \renewcommand\thesubpart{\arabic{subpart}}.

\subpartname
The \subpart command utilizes \subpartname (with automatic translation in several languages according to the chosen language), as well as \labelsupart and \labelsupartstyle, all of which can be modified.

\subpart*
Similar to \exercise*, the starred version \subpart*{⟨opt⟩}{⟨label⟩} permits an alternative ⟨label⟩ and omits the numbering. For instance, you can use \subpart*(First part).

2.3 The \annex command
\annex
The \annex{⟨opt⟩} command composes the title ANNEX in uppercase letters, centered, using the subsection style, with an optional parameter that will be added on the same line.

<table>
<thead>
<tr>
<th>ANNEX (to be returned)</th>
</tr>
</thead>
</table>

\annexname
The term “Annex” is automatically translated into several languages (depending on the chosen language). It can be extended to additional languages or altered by redefining \annexname or by utilizing macros from the translations package [7].

\annexstyle
The style of the annex title is determined by the \annexstyle macro, which is defined as follows: \newcommand\annexstyle{\MakeUppercase}. This command may be redefined according to your preferences.

2.4 Titles in the table of contents
[exetoc=⟨bool⟩]
By default, the titles Exercise, Part and Annex are included in the table of contents, if there is any, or in the PDF file’s summary when the hyperref package is utilized. To prevent this, you can set the package option exetoc=false (with the default being true). However, note that optional title arguments will always be ignored in the table of contents.

2.5 Short exercises: the \exe command
\exe
The \exe command initiates an exercise with the abbreviation Ex. followed by the exercise number. This is achieved without utilizing sectioning commands, and the exercise content begins on the same line. An exercise begins a new paragraph without any indentation.

| Ex. 4 — This is a brief exercise that can encompass several paragraphs or questions. |
| Here for example a new paragraph begins. |
| Ex. 5 — This is another concise exercise. |
The abbreviation \texttt{Ex} can be modified by redefining \texttt{exname} or with macros from the \texttt{translations} package \cite{translations}. The \texttt{exlabel} macro combines \texttt{exname} with a period then the exercise number (given by the same \texttt{exercise} counter), while \texttt{exsepmark} typesets a long dash. These characteristics can be altered by redefining these commands.

The starred version doesn’t display a separator, as demonstrated below:

\begin{ex}
\textit{Ex. 6} Another short exercise without a separator.
\end{ex}

\section{Enumerations and lists}

\subsection{List settings}

Enumeration lists are used to represent questions and sub-questions within exercises. To provide clear emphasis, labels are typeset in bold. Additionally, these labels are aligned to the left, positioned at the start of the line without indentation, and the vertical spacing between items is increased compared to standard \LaTeX lists. These formatting adjustments are achieved using the \texttt{setlist} command, a feature from the \texttt{enumitem} package by Javier Bezos \cite{enumitem}.

\begin{exercise}
\item First question
  \begin{enumerate}[(a)]
  \item First sub-question
  \item Second sub-question
  \end{enumerate}
\item Second question
\end{exercise}

The \texttt{enumerate} environment takes an optional parameter, that allows, among others things, the typesetting of alternative list labels. For instance, typing \begin{enumerate} [label=\textup{\textbf{A}.}),font=\textit{\normalfont}]\end{enumerate} will yield the labels “\textbf{a}), \textit{b}), \textbf{c})…”\footnote{Labels can also be modified using a "shortlabel" argument, e.g. \begin{enumerate} [label=\textup{\textit{A}.})]\end{enumerate}, or globally through the redefinition of \texttt{\labelenumi} or \texttt{\labelenumii} commands.}. There are many other options available (see the \texttt{enumitem} \cite{enumitem} package documentation)\footnote{However, the \texttt{french} option of the \texttt{babel} package changes the appearance of \texttt{itemize} lists and employs long dashes as labels for each list level. This can cause issues when mathematical content follows the dash symbol, as it might be mistaken for the minus sign. Thus, with the option \texttt{setlist=true}, the default \LaTeX \texttt{itemize} list style is reinstated with \texttt{\frenchsetup{StandardLists=true}}.).

Lists created with the \texttt{itemize} environment retain their default configuration\footnote{The package option \texttt{setlist=false} prevents changes to enumeration lists and reverts to the default \LaTeX settings (the default value is \texttt{true}).}.

\subsection{List of exercises : the \texttt{exenumerate} environment}

When an exercise sheet consists of short, independent questions, it might be unreasonable to display the full title \textbf{Exercise} for each one. In addition to the previously
mentioned \texttt{\textbackslash exe} command, we offer an even more streamlined solution using the \texttt{exenumerate} environment. This environment is essentially an enumeration list with increased spacing between items, compared to the \texttt{enumerate} environment. Here is an example (the main list uses the \texttt{exenumerate} environment, while the sub-list is created using the standard \texttt{enumerate} environment):

1. Translate the following sentences in English:
   (a) Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi.
   (b) Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus.

2. Translate the following sentence in German:
   Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi.

3. Translate the following sentence in French:
   Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

The \texttt{exenumerate} environment (also based on the \texttt{enumitem} package) accepts an optional parameter, similar to the \texttt{enumerate} environment.

3.3 Items aligned by row: \texttt{tablenum1, tablenuma, tablitem}  

These three environments are employed to typeset brief questions (\texttt{tablenum1}), sub-questions (\texttt{tablenuma}) or \texttt{itemize} lists (\texttt{tablitem}) on the same line. They share the same syntax: \texttt{\begin{tablenum1}[(opt)]{(cols)}\end{tablenum1}}. The \texttt{\begin{tablenum1}} parameter denotes the number of columns utilized by the environment. It must be enclosed in parentheses. This parameter can be omitted, in which case its default value is 2. Similar to conventional lists, each item is initiated with the \texttt{\item} command.

Internally we have utilized the \texttt{\NewTasksEnvironment} macro from the \texttt{tasks} package by Clemens Niederberger. The usage of the optional argument \texttt{(opt)} is explained in the documentation of this package. For example, similar to the \texttt{enumitem} package, \texttt{\item\{\textbackslash arabic\}} produces an Arabic numbering followed by a closing parenthesis. Additionally there are numerous possibilities for arranging items in original ways. For instance, the \texttt{\item*} command allows you to specify the number of columns the item is supposed to span. In the subsequent example, the five \texttt{\item} commands are sequentially positioned between \texttt{\begin{tablenum1}(3)} and \texttt{\end{tablenum1}}. Notice that numbering occurs line by line in this context.

\begin{exercise}

Calculate the derivative of the following functions:

1. \( f(x) = \frac{1-x^2}{e^x + e^{-x}} \),
2. \( g(x) = \ln \left( \frac{1-x}{1+x^2} \right) \),
3. \( h(x) = \int_0^1 e^{xy} \, dy \),
4. \( k(x) = \sum_{i=1}^{\infty} \frac{1}{x^i} \),
5. \( l(x) = \int_{\frac{1}{2}}^{x} \frac{1}{\ln t} \, dt \).

\end{exercise}
For \texttt{tablenum}, labels are letters, a, b, c, ..., enclosed in parentheses.

You can change the labels by redefining the macros \texttt{\labelenumone} (for \texttt{tablenum1}) and \texttt{\labelenuma} (for \texttt{tablenuma}), using the \texttt{task} counter: e.g. \texttt{\renewcommand\labelenuma{\Alph{\texttt{task}}}} yields the labels A, B, etc.

With the default option \texttt{setlist=true}, the font of all enumeration labels may be changed by redefining \texttt{\enumfont} (\texttt{\bfseries} by default). If the \texttt{exeshell} package is invoked with the option \texttt{setlist=false}, labels within \texttt{tablenum1} and \texttt{tablenuma} environments will be presented with indentation, and in normal font rather than bold. You can change the label formatting globally with the command \texttt{\settask}, e.g. \texttt{\settask\{label-format=\texttt{\itshape}\}}. You can also completely redefine the environments using \texttt{\RenewTasksEnvironment}. When \texttt{setlist=true}, place these commands after \texttt{\begin{document}}.

When you intend to utilize \texttt{tablenuma} (or \texttt{tablitem}) immediately after inserting \texttt{\item} command within an \texttt{enumerate} environment, a vertical misplacement may occur. To achieve proper vertical spacing in such cases, we offer the starred environments \texttt{tablenuma*} and \texttt{tablitem*}, with corrected alignment as shown below:

\begin{tablenuma*}
\begin{enumerate}
\item (a) One
\item (b) Two
\item (c) Three
\end{enumerate}
\end{tablenuma*}

If the vertical alignment is still not perfect, include \texttt{\mbox{}}\vspace{\texttt{⟨height⟩}} just after \texttt{\item} and before invoking \texttt{\begin{tablenuma*}} (or \texttt{\begin{tablitem*}}), where \texttt{⟨height⟩} can be a positive or negative length.

3.4 Items aligned by column: \texttt{colsenum, colsitem}

To achieve numbering of items by column, we provide the \texttt{colsenum} environment: \texttt{\begin{colsenum}{⟨opt⟩}{⟨cols⟩}}. The mandatory parameter is the number of columns, and the optional parameter will be passed to the underlying \texttt{enumerate} environment, allowing you to change the numbering type (e.g. a, A, etc.), among other possibilities. To use this environment, you need to load the \texttt{multicol} package in the preamble. Here’s an example with \texttt{\begin{colsenum}{3}}:

\textbf{Exercise 9}

Calculate the derivative of the following functions:

\begin{enumerate}
\item $f(x) = \frac{1 - x^2}{e^x + e^{-x}}$, \hspace{1cm} \item $h(x) = \int_0^1 e^{xy} \, dy$, \hspace{1cm} \item $l(x) = \int_{\frac{1}{2}}^x \frac{1}{\ln t} \, dt$.
\item $g(x) = \ln \left( \frac{1 - x}{1 + x^2} \right)$, \hspace{1cm} \item $k(x) = \sum_{i=1}^{\infty} \frac{1}{x^i}$.
\end{enumerate}

It may be observed that, on each line, items are not necessarily properly aligned, which can result in ungraceful effects. On the other hand, the \texttt{colsenum} environment doesn’t attempt to align columns from the bottom by adjusting the vertical spacing between items. If you desire this alignment (which is the default behavior in \texttt{multicol}), you can use the \texttt{colsenum*} environment (with the same syntax as \texttt{colsenum}). Here’s what we obtain with \texttt{colsenum*}:
Exercise 10

Calculate the derivative of the following functions:

1. \( f(x) = \frac{1 - x^2}{e^x + e^{-x}} \),  
2. \( g(x) = \ln \left( \frac{1 - x}{1 + x^2} \right) \),  
3. \( h(x) = \int_0^1 e^{xy} \, dy \),  
4. \( k(x) = \sum_{i=1}^\infty \frac{1}{x^i} \),  
5. \( l(x) = \int_{\frac{1}{2}}^{x} \frac{1}{\ln t} \, dt \).

We can observe that these alignments are not as elegant as those achieved through row numbering. However, column numbering might still be more suitable when dealing with numerous items of varying heights, and especially when the number of items can differ from column to column. Additionally, a benefit of \texttt{colsenum} is that the label selection is automatic, based on the list level (and the language), unlike \texttt{tablenum1} or \texttt{tablenuma}.

\texttt{colsitem}  
For \texttt{itemize} lists, the \texttt{colsitem} environment generates items aligned by column, unlike the line-by-line alignment of \texttt{tablitem}. It follows the same syntax as \texttt{colsenum}: \texttt{\begin{colsitem}((opt))\{cols\}}. The optional parameter, passed to the underlying \texttt{itemize} environment, allow to change the item label (bullet by default). Furthermore, just like \texttt{colsenum*}, the \texttt{colsitem*} environment produces column alignment from the bottom. The \texttt{multicol} package is also required and must be loaded in the preamble.

4 Questions and solutions

4.1 Environments questions and answers

The \texttt{exesheet} package offers two environments, \texttt{questions} and \texttt{answers}, which allow you to optionally show or hide questions and answers within exercises.

The output is governed by the \texttt{output} key option which recognizes three values: \texttt{questions}, \texttt{answers}, and \texttt{both}. The \texttt{questions} value shows only questions without answers, \texttt{answers} displays answers without questions, and \texttt{both} (the default option) displays both questions and answers.

\texttt{\correctionstyle}  
\texttt{\correctioncolor}  
In the default case where both questions and answers are displayed, the answers are typeset using the \texttt{\correctionstyle} style, which utilizes the color \texttt{\correctioncolor}. You can modify this color using the \texttt{\definecolor} macro\footnote{The \texttt{\definecolor} command is provided by the \texttt{xcolor} package developed by Uwe Kern, which is automatically loaded by \texttt{exesheet}.}. By default, \texttt{\definecolor{correctioncolor}{rgb}{0,0.2,0.6}} is used, resulting in a kind of dark blue.

\texttt{\correctionname}  
Furthermore, when using \texttt{output=both} the title \texttt{Correction} is displayed at the beginning of \texttt{answers} environments. This title is defined by the \texttt{\correctionname} macro, with translation available in several languages, and it can also be modified. For instance you might prefer “Solution” over “Correction”. The style defined by \texttt{\correctionstyle} will be applied to the title as well as the entire environment. Here’s an example to illustrate this:
Exercise 11
1. Is the \texttt{exesheet} package useful?

2. Aren’t there any other packages that deal with exercises?

Correction
1. The \texttt{exesheet} package is useful for teachers.

2. There are numerous other packages that handle exercises and provide the capability to create questions and solutions separately. For instance the \texttt{exercise} package by Paul Pichaureau, \texttt{exercises} by Roger Jud, \texttt{exsheets} (now superseded by \texttt{xsin}) by Clemens Niederberger, \texttt{exframe} by Niklas Beisert, \texttt{exam} by Philip Hirschhorn, \texttt{answers} by Mike Piff and Joseph Wright, \texttt{probsoln} by Nicola Talbot, \texttt{eqexam} by D. P. Story... They are briefly presented in section 6.3.

When only answers are displayed, the text color remains black and the word “Correction” is not displayed.

4.2 More about \texttt{answers} environments

Internally, we have utilized the \texttt{\textbackslash comment} and \texttt{\textbackslash endcomment} macros from the \texttt{versions} package by Uwe Lück [5]. Moreover, the \texttt{versions} package [5] offers the \texttt{\textbackslash excludeversion\{⟨env⟩\}} and \texttt{\textbackslash includeversion\{⟨env⟩\}} macros which allow for the exclusion or inclusion of any environment \langle env⟩. These “optional” environments can be nested.

However the \texttt{questions} and \texttt{answers} environments serve a broader purpose beyond merely displaying or hiding text. You can choose to have a single answers environment for the entire sheet, or alternatively, have separate answers environments for each exercise, exercise part, question, or sub-question. The format in which the title \texttt{Correction} should appear in the output, and its placement in the table of contents or PDF file summary, depends on the nesting level of the environment. In fact, the rendering of the \texttt{Correction} title and its corresponding table of contents level will be automatically calculated by the environment.

\begin{answers}[⟨level⟩]

\end{answers}

However, users might wish to adjust the title’s level themselves. To achieve this, you can manually set the level of the title “Correction” using an optional \langle level\rangle argument which is defined as follows: 1 for section-level titles, 2 for subsections (akin to \texttt{Exercise}), 3 for sub-subsections (similar to \texttt{Part}), other numbers for lower levels (which won’t appear in the table of contents or in the PDF file’s summary).

Caution should be taken that, if the \texttt{questions} environment is not used beforehand in the same exercise (or part), the \texttt{answers} environment will consider the correction as global for the entire sheet (or exercise) and will reset the \texttt{exercise} (or \texttt{part}) counter. This can be managed properly with the optional argument. For example, use \texttt{\begin{answers}[2]} to prevent \texttt{exercise} counter reset, or \texttt{\begin{answers}[3]} to prevent \texttt{subpart} counter reset.

\begin{answers*}

\end{answers*}

The starred version \texttt{answers*} doesn’t display the \texttt{Correction} title.
4.3 Commands \question, \answer and \answerspace

Instead of using questions and answers environments, we can also employ the simpler \question{⟨ques⟩} and \answer{⟨ans⟩} macros. The visibility of {⟨ques⟩} and {⟨ans⟩} content is regulated by the same previous output=⟨opt⟩ key option. This approach might be more fitting when you wish to display answers immediately after each question item. The title “Correction” won’t appear at the start of each answer with the \answer macro. The answers are also formatted using \correctionstyle if output=both. However these commands do not support \verbatim text within them, unlike the questions and answers environments.

\question* \answer* When a code must be executed only when questions are displayed but not answers, or the contrary, you have the starred versions e.g. \question*{\pagebreak}.

\answerspace Some teachers are accustomed to providing their students with documents where questions are typeset, leaving blank spaces instead of answers. This layout allows students to fill in their responses on the paper. Thanks to a suggestion from Maxime Chupin, we achieve this with the \answerspace{⟨height⟩} macro, in which the parameter ⟨height⟩ is a valid length, e.g. \answerspace{3cm}.

\answerspace*[\answerspace=⟨bool⟩] The blank spaces introduced by \answerspace can be displayed or hidden, controlled by the \answerspace option key, which can be set to either true or false (the default). The \answerspace key option has no effect (equivalent to false) when the answers are displayed (output=answers or both). Of course the \answerspace macro is not meant to be used within answers environments.

5 Marking scheme commands

The exesheet package provides several commands to display a marking scheme, with optional comments and explanations about answers in the margins.

5.1 The \points command

\points The \points{⟨pts⟩} command displays the number of points awarded for an exercise. It is intended to be included in the optional argument of the \exercise command. In the following example, we used \exercise{\points{5}}:

<table>
<thead>
<tr>
<th>Exercise 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Try to read this document to the end without drinking tea and you get five points.</td>
</tr>
</tbody>
</table>

When only the answers are displayed in an exercise, the \points macro doesn’t show the points. Further, we provide another macro, which displays points in questions like here, and differently in answers environments (see section 5.5).

\pointsname \pointsname The term “points” (or “point” in the singular if ⟨pts⟩ is less than 2) is appended and is automatically translated into several languages (and can also be modified).

\pointsstyle \pointsstyle You can adjust the \points command’s style through \pointsstyle. The color setting (red by default) is managed by \pointscolor using \definecolor, for example you can declare: \definecolor{pointscolor}{named}{blue}.

\footnote{However using \points in the optional argument of \exercise is not compatible with the memoir class, as the memoir class redefines section commands.}
5.2 The \pts command

\pts When exercises are typeset using the \exe macro or as a list with the exenumterate environment, the marking scheme can be shown in the margin, aligned with the line where the \pts\{\langle num\rangle\} command is placed (typically the first line of the exercise). The \langle num\rangle parameter represents the number of points assigned to the exercise. Here’s an example with \exe\pts{3}... \exe\pts{1.5}...

| (3 pts) | Ex. 13 — The first short exercise with a marking scheme. |
| (1.5 pt) | Ex. 14 — The second one. |

\ptsname The abbreviation “pts” (or “pt” when the number of points is less than 2) is added automatically using \ptsname macro (translated in several languages if babel or polyglossia is loaded). The point’s display color is defined by \ptscolor, changeable via \definecolor (red by default). The display style is determined by \ptsstyle, which among other things, adds parenthesis around.

\[\text{display}=(\text{opt})\] The marking scheme visibility is controlled by the display option key. The default option is display=none, keeping the marking scheme hidden. To reveal the marking scheme, use display=pts. More details are available in section 5.4.

\[\text{marginpos}=(\text{opt})\] The positioning of the scale is determined by the marginpos option key, typically left or right. The default value is left even though \LaTeX positions marginal notes on the right side by default. This option has no impact when display=none.

For a two-sided document, the default behavior is to place text in the outer margin, which is wider than the inner margin (that contains the binding). The outer margin is positioned on the right side on odd pages and on the left side on even pages. Therefore, the marginpos option can also take the values inner or outer. If you specify left or right when the twoside mode is activated, this value will be converted to outer, accompanied by a warning message.

With the twoside mode, marginal notes might occasionally appear on the wrong side of a page. This is a known \LaTeX bug, and the solution involves using the mparhack package by Tom Sgouros and Stefan Ulrich [9] (which esexsheet automatically includes for documents in two-side mode) and running \LaTeX twice. If necessary, a warning message will prompt you to perform the re-run.

5.3 Commands \totalexe, \note* and \note

For a more comprehensive marking scheme, the following commands are available.

\totalexe The \totalexe\{\langle num\rangle\} macro displays the total number of points of an exercise. By default, it appears inside an oval box, with the addition of the word “pts” (or “pt”) in bold red. In the following example, the exercise title has been generated using \exercise, \totalexe{4}.

\\note* For each answer or solution in the correct version, the \note*\{\langle num\rangle\} command indicates the number of points allocated to that question. The appearance slightly varies compared to \pts: by default the number is displayed in bold without the “pts” or “pt” suffix, and without parenthesis. In the following example, for answer 3, we employed \note*{1.5}, placed right after \item.
\texttt{\textbackslash note} \quad The \texttt{\textbackslash note}(\texttt{\textlangle}comment\texttt{\textrangle}) macro is utilized to provide additional information regarding the marking scheme and to explain how points are assigned. In the \texttt{\langle comment\texttt{\textrangle}) argument you can use \texttt{\textbackslash \} to create a line break or even \texttt{\textbackslash \langle(height\texttt{\textrangle)}} to adjust the line spacing by \texttt{(height)}.

\texttt{\textbackslash note[\texttt{(num)\texttt{\textrangle}] \quad} Placing \texttt{\textbackslash note[\texttt{(num)\texttt{\textrangle}]\texttt{\textbackslash note}(\texttt{\textlangle}comment\texttt{\textrangle)}} at the beginning of an answer is often practical. In such cases \LaTeX will align the margin notes vertically, which leads to a warning like: \texttt{LaTeX Warning: Marginpar on page ... moved}. However, this warning is not an issue, as \LaTeX can usually handle the arrangement of these marginal notes, stacking them one below the other. Nonetheless, to prevent unnecessary warnings, you can combine both commands into a single one by specifying the number of points as an optional argument of the \texttt{\textbackslash note} command: \texttt{\textbackslash note[\texttt{(num)\texttt{\textrangle}]\texttt{\textbackslash note}(\texttt{\textlangle}comment\texttt{\textrangle)}}.

The initial comment in the following example is generated (immediately after \texttt{\item}) using \texttt{\textbackslash note[1]{0.5 for the anti-derivative\0.5 for simplifying}}.

\begin{center}
\begin{tikzpicture}
\begin{scope}[every node/.style={fill=white,draw,rounded corners}, every path/.style={draw,thick}]
\node (a) {Exercise 15};
\node (b) [below=of a] {For each subsequent question, determine whether the statement is true or false. Provide a thorough justification for your answer.};
\node (c) [below=of b] {1. \( \int_0^{\sqrt{3}} \frac{1}{x + \sqrt{3}} \, dx = \ln 2 \),
2. \( \int_2^e \frac{1}{x \ln x} \, dx = -\ln 2 \),
3. The function \( F \), defined on \( \mathbb{R} \) by \( F(x) = \int_0^{\sqrt[3]{x}} \frac{1}{t^2 + t + 1} \, dt \), is increasing on \( \mathbb{R} \).};
\node (d) [below=of c] {Correction};
\node (e) [below=of d] {1. We calculate:
\[
\int_0^{\sqrt{3}} \frac{1}{x + \sqrt{3}} \, dx = \left[ \ln \left(x + \sqrt{3}\right) \right]_0^{\sqrt{3}} = \ln \left(2\sqrt{3}\right) - \ln \sqrt{3} = \ln \left(\frac{2\sqrt{3}}{\sqrt{3}}\right) = \ln 2.
\]
\textbf{TRUE}.
2. We have \( \frac{1}{x \ln x} = \frac{1}{\ln x} = \frac{u'(x)}{u(x)} \) with \( u(x) = \ln x \), which is positive on \([2, e]\).
Hence
\[
\int_2^e \frac{1}{x \ln x} \, dx = \left[ \ln(\ln x) \right]^e_2 = \ln(\ln e) - \ln(\ln 2) = 1 - \ln(\ln 2) = -\ln(\ln 2).
\]
\textbf{FALSE}.
3. The function \( F \), defined on \( \mathbb{R} \) by
\[
F(x) = \int_0^{\sqrt[3]{x}} \frac{1}{t^2 + t + 1} \, dt,
\]
is derivable on \( \mathbb{R} \) and its derivative is such that \( F'(x) = \frac{1}{x^2 + x + 1} \). The denominator is a quadratic polynomial, always positive because its discriminant is \( \Delta = -3 < 0 \). Thus \( F \) is increasing on \( \mathbb{R} \).
\textbf{TRUE}.
\end{scope}
\end{tikzpicture}
\end{center}
In the comment for answer 2, a larger vertical space is created with the optional argument `\[2ex]` for line break. The last comment, which isn’t positioned next to the points number, was produced by placing the following on the first line after the formula: `\note{0.5 for $F'$\$\1 for the sign of $F'$ and conclusion}.`

The color and style for displaying points in `\totalxe` and `\note*` can be customized using `\markingcolor` and `\markingstyle`, respectively. The oval box produced by `\totalxe` is created using the `\ovalbox` command from the `fancybox` package by Timothy Van Zandt [6], with corner arcs set by `\cornersize{1}`. The box’s length is determined by `\ptsboxlength`, and not by the box’s content, to ensure uniformity across exercises.

By default, comment notes are typeset in a dark green color defined by `\definecolor{notecolor}{rgb}{0.0,0.4,0.0}`. The style of comments is determined by the `\notestyle` macro.

### 5.4 Margin notes options

- **display=(opt)** The `display` key option governs the presentation of the marking scheme: as discussed previously (subsection 5.2), `display=none` shows nothing. When using `display=pts` the numbers provided as arguments to `\pts`, `\totalxe`, `\note*` or as optional arguments of `\note{⟨num⟩}{…}` will be exhibited. The final option is `display=notes` which reveals the complete marginal notes, containing points and comments (the mandatory argument of `\note`), as illustrated in the previous example.

- **marginpos=(opt)** As previously mentioned in subsection 5.2, the side on which to position the scale is determined by the `marginpos` key option, with possible values of `left` and `right` (or `inner` and `outer` if the document is in `twoside` mode).

- **marginwidth=(opt)** The margin layout is governed by the `marginwidth` key option, which can take one of the following values: `standard`, `expand`, or `unset`.

  This option has no effect when `display=none`. In this case, both the left and right margins have the same width, except in a two-sided document where the ratio between the left and right margins is 2:3. Otherwise the `marginwidth` key option behaves as follows:

  - **standard** The left margin is widened, and the right margin is reduced, with a ratio of 3:2 (or 2:3 if `marginpos=right`). The text body is shifted without changing its width. The margin paragraph width remains relatively short (depends on page geometry). This option is not ideal for lengthy comments.

  - **expand** (default value) The behavior is the same as with the `standard` value when `display=pts`. However, when `display=notes`, the margin expands with a ratio of 3:1 (or 1:3) and the width of margin paragraphs increases.

  - **unset** This option is provided for cases where the previous settings are not suitable. In this case, no adjustments are made to the margin width. Instead, you can define your own settings using the convenient `\geometry` macro from the `geometry` package by Hideo Umeki [2]. For instance, you can place the following in the preamble:

    `\geometry{hmarginratio=2:1,marginparwidth=2.5cm}`.

    If `marginpos=right`, you need to invert the ratio, e.g. 1:2 instead of 2:1. If `marginwidth` is not set to `unset`, such a command will have no effect.
Margin settings are applicable to the entire document and need to be configured in the preamble.

\[\text{noteragged=}\langle\text{opt}\rangle\]

The package option noteragged controls the text alignment within the margins for the mandatory argument of \texttt{\textbackslash note}. It offers the following values: left, right, center, justify or twoside. The default value is noteragged=left, resulting in right-aligned text, which is common for text in the left margin. When noteragged=right, the text is left-aligned. Using justify makes the text justified, aligning with \LaTeX{}’s default behavior for marginal notes. Finally noteragged=twoside aligns text to the left on odd pages and to the right on even pages in a two-sided document. It has no effect otherwise (the default noteragged=left is used and a warning message appears in the terminal).

When display is not set to notes, the noteragged option has no impact, as it specifically applies to text within the mandatory argument of \texttt{\textbackslash note}.

5.5 The \texttt{\textbackslash totalpoints} command

\texttt{\textbackslash totalpoints}\{(\texttt{\textbackslash num})\} macro serves as a replacement for \texttt{\textbackslash points} when using a comprehensive marking scheme. When the scale is not displayed, it functions similarly to \texttt{\textbackslash points} (visible in questions but not in answers), and when the scale is shown, it’s akin to \texttt{\textbackslash totalex}. For instance, in exercise 15, we could have used \texttt{\textbackslash totalpoints} instead of \texttt{\textbackslash totalex}. Thus, if the detailed marking scheme is not displayed, the total points would be presented similarly to exercise 5.1.

5.6 Marking scheme consistency checking

\[\text{checkpts=}\langle\text{bool}\rangle\]

The marking scheme can be checked out\footnote{Thanks to Denis Bitouzé for his suggestion about this feature.} using the key-val option checkpts=true (or just checkpts); the default value is false.

For each exercise, the cumulative points allocated to each question (via \texttt{\textbackslash pts}, \texttt{\textbackslash note*} or \texttt{\textbackslash note[ ]} are compared to the exercise’s total specified in \texttt{\textbackslash points}, \texttt{\textbackslash totalex} or \texttt{\textbackslash totalpoints}. A warning message will be displayed in the shell to indicate whether the scale is valid for the exercise or not. For example:

Package exesheet warning: Exercise 3: Sum of points is 4.5pt instead of 5pt.

Both comma notation (e.g. 4,5) and decimal point format (e.g. 4.5) may be accepted, depending on your chosen language. The control is made at the beginning of the subsequent exercise, inside the \texttt{\textbackslash points}, \texttt{\textbackslash totalex} or \texttt{\textbackslash totalpoints} macros. No deep checking will be processed at this level if no points are displayed for the questions inside the exercise (with display=none option).

\texttt{\textbackslash totalsheet} \ At the end of the document, the last exercise is checked, followed by a global examination of the entire sheet. This last task requires knowledge of the total points for the sheet, which must be given by the \texttt{\textbackslash totalsheet}\{(\texttt{\textbackslash points})\} macro in the preamble; otherwise, a warning message will be displayed. If subtotals have been assigned to exercises and displayed, the overall comparison is made between the sum of these subtotals and the total points recorded using \texttt{\textbackslash totalsheet}. If not, the evaluation encompasses the sum of points for each individual question. A subsequent warning message indicates the outcome of this last verification. Finally, a message indicates whether all scale controls have been successfully passed or not.


6 Options and comparison with other packages

6.1 Summary of available options

Here we provide a summary table of the available options. Details on their usage can be found in the respective sections. The default value is displayed in bold.

<table>
<thead>
<tr>
<th>Key</th>
<th>Possible values</th>
<th>See section</th>
</tr>
</thead>
<tbody>
<tr>
<td>exetoc</td>
<td>true, false</td>
<td>2.4</td>
</tr>
<tr>
<td>setlist</td>
<td>true, false</td>
<td>3.1</td>
</tr>
<tr>
<td>output</td>
<td>questions, answers, both</td>
<td>4.1</td>
</tr>
<tr>
<td>answerspace</td>
<td>true, false</td>
<td>4.3</td>
</tr>
<tr>
<td>display</td>
<td>none, pts, notes</td>
<td>5.2, 5.4</td>
</tr>
<tr>
<td>marginpos</td>
<td>left (inner), right (outer)</td>
<td>5.2, 5.4</td>
</tr>
<tr>
<td>marginwidth</td>
<td>standard, expand, unset</td>
<td>5.4</td>
</tr>
<tr>
<td>noteragged</td>
<td>left, right, center, justify, twoside</td>
<td>5.4</td>
</tr>
<tr>
<td>checkpts</td>
<td>true, false</td>
<td>5.6</td>
</tr>
<tr>
<td>correct</td>
<td>true, false, conditional</td>
<td>see below</td>
</tr>
</tbody>
</table>

When an invalid key is provided, an error is generated. However, an unrecognized value only triggers a warning message:

Value ... is not supported by ... option on input line ...

For each option, you can set them through the class or package invocation, e.g.
\usepackage[output=answers,display=notes,noteragged=right]{exesheet}

\exesheetset{list of (key)=(value)}

You can also use the \exesheetset{list of (key)=(value)} command. Note that some options, output, answerspace, display, and noteragged, can be changed dynamically, even within the document, while the others are applicable in the preamble exclusively. Dynamic options are processed with each call, whereas the others are processed once, at the beginning of the document.

\[correct=(opt)\]

A special option, correct, can be employed when using the exesheet class or in conjunction with the schooldocs package. This option adds “Correct version” (or its translation) to the document title and headers. Possible values are: true, false (by default) or conditional. Using correct=conditional, it behaves as true when answers are displayed and false when they’re not.

6.2 Alternative commands

Prior to version 2.0, we used specialized commands to configure output and display options. We have now implemented key=value options. Although the latter are more user-friendly, one may prefer the old commands, so they are still supported, but will trigger a warning message. These commands are presented below.

However, the previous options nosetlist and notoc are no longer supported.

\questiononly\answersonly\displaypts\displaypoints

The command \questiononly\answersonly\displaypts\displaypoints are equivalent to setting output=questions\answers and display=pts.
\displaynotes \displaynotesright \displaynotes means \texttt{display=notes}, and \texttt{\displaynotesright} corresponds to \texttt{display=notes,marginpos=right}. These two commands have an optional argument \texttt{\displaynotes\{⟨ragged⟩\}} where \texttt{⟨ragged⟩} is an alignment command to work inside margin notes. By default it is \texttt{\RaggedLeft} with \texttt{\displaynotes} and \texttt{\RaggedRight} with \texttt{\displaynotesright}.

6.3 Comparison with other packages

In this section, we will provide an overview of the functionalities (as of today February 13, 2024) of various packages or classes found in the ‘Exercise’ or ‘Exam’ sections of the CTAN archives (Comprehensive TeX Archive Network). Considering the substantial number of packages in these sections, some omissions may have been unintentionally made. Those excluded are those with documentation not in English or primarily dedicated to producing multiple-choice questions or random question generation. We have focused here on typesetting functionalities and not on managing exercise databases as there are specialized packages or external softwares for that.

The following table is not a result of tests but presents a summary of information collected from the documentation of these packages.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
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<tbody>
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</tr>
<tr>
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<tr>
<td>Hiding questions or answers*</td>
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<td>Blank spacing in place of answers</td>
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</tbody>
</table>

*These commands come from the \texttt{ragged2e} package by Martin Schröder [8].
7 Implementation

7.1 Options and required packages

The \texttt{exesheet} class is build upon the \texttt{article} class and transfers all its unknown options to it. The use of \texttt{\ProcessKeyvalOptions} is unnecessary within the class as it will be managed by the package.

\begin{verbatim}
\RequirePackage{kvoptions}
\DeclareBoolOption[true]{exetoc}
\DeclareBoolOption[true]{setlist}
\DeclareStringOption[both]{output}
\DeclareStringOption[none]{display}
\DeclareBoolOption[false]{answerspace}
\DeclareStringOption[left]{marginpos}
\DeclareStringOption[expand]{marginwidth}
\DeclareStringOption[left]{noteragged}
\DeclareBoolOption[false]{checkpts}
\DeclareStringOption[false]{correct}
\PassOptionsToClass{\CurrentOption}{article}
\ProcessOptions \relax
\LoadClass{article}
\RequirePackage{exesheet}
\RequirePackage{schooldocs}
\end{verbatim}

Options are defined using the \texttt{kvoptions} package. String options are managed through distinct processing macros that are implemented in their respective sections. For options whose effects cannot be dynamically altered and must be configured in the preamble, they are processed once, at \texttt{\begin{document}}. The other options are executed when this package is loaded (at the end of the package, as \texttt{\exs@process...} commands are not recognized at the outset).

A distinct case is to mention with \texttt{setlist} when utilized in conjunction with \texttt{babel-french}. In this instance, this option is processed immediately (further clarification follows below).

\begin{verbatim}
\@ifclassloaded{exesheet}{}{
 \RequirePackage{kvoptions}
 \DeclareBoolOption[true]{exetoc}
 \DeclareBoolOption[true]{setlist}
 \DeclareStringOption[both]{output}
 \DeclareStringOption[none]{display}
 \DeclareBoolOption[false]{answerspace}
 \DeclareStringOption[left]{marginpos}
 \DeclareStringOption[expand]{marginwidth}
 \DeclareStringOption[left]{noteragged}
 \DeclareBoolOption[false]{checkpts}
 \DeclareStringOption[false]{correct}
}
\ProcessKeyvalOptions*
\PackageInfo{exesheet}{The options ‘notoc’ and ‘nosetlist’
\end{verbatim}
The `\exesheetset` macro can accept key-val options and can be utilized anywhere in the document to adjust certain settings. However, it won’t affect non dynamic options if called outside the preamble. In such cases a warning message occur due to the use of `\DisableKeyvalOption`.

```
def\exesheetset#1\setkeys{exesheet}{#1}\exs@process@dynoptions
```

The following old macros (used before version 2.0) provide an alternative to keyval options. They are kept for compatibility reasons.

```
def\questionsonly{\PackageWarning{exesheet}{Old command \string\questionsonly\space is used. \MessageBreak It can be replaced by the option ‘output=questions’})\renewcommand\exesheet@output{questions}\exs@process@output}
def\answersonly{\PackageWarning{exesheet}{Old command \string\answersonly\space is used. \MessageBreak It can be replaced by the option ‘output=answers’})\renewcommand\exesheet@output{answers}\exs@process@output}
def\displaypts{% \PackageWarning{exesheet}{Old command \string\displaypts\space is used. \MessageBreak}
```
Now, we load several packages. If the \texttt{geometry} package is already loaded, it will not be reloaded to prevent an option clash. The \texttt{shortlabel} option in the \texttt{enumitem} package allows the use of labels similar to the \texttt{enumerate} package such as 1., a), A., and so on. The \texttt{mparhack} package by Tom Sgouros and Stefan Ulrich is loaded exclusively for documents in \texttt{twoside} mode.

\input{15-7-2Internationalization}

\subsection{Internationalization}

Here we define keywords along with their translations in French, German, Spanish, Italian, Portuguese. We achieve this using macros from the \texttt{translations} package by Clemens Niederberger. This package automatically detects the language being used, as loaded by \texttt{babel} or \texttt{polyglossia}.
7.3 Titles

The exercise counter assigns numbers to exercises throughout the entire document, regardless of sections. To reset the counter manually, simply use \setcounter{exercise}{0}. For an automatic reset at each new section, include the following code in the preamble
\makeatletter \@addtoreset{exercise}{section} \makeatother.

The parts counter (subpart) depends on the exercise counter and is reset with each new exercise.

The commands \labelexercisestyle and \labelsubpartstyle are initially empty, but they allow you to customize the styling. For example:\renewcommand\labelexercisestyle{\sffamily}.

The \exe@label macro, which needs the exe@check counter, will be used inside warning messages about the marking scheme (see section 7.6).

By default, the table of contents includes both exercises and parts titles, as controlled by the boolean \ifexesheet@exetoc. To only display exercise titles in the table of contents while omitting parts, include the following code in the preamble: \setcounter{tocdepth}{2}.

\exercise

\newcounter{exercise}
\newcounter{exe@check}
\newcommand\labelexercise{\exercisename\space \theexercise}
\newcommand{\labelexercisestyle}{}
\section*{7.4 Enumerations and lists}

The \texttt{setlist} command is part of the \texttt{enumitem} package (\texttt{setenumerate} is deprecated). By default, \texttt{itemsep=1ex} is set for first-level lists, and \texttt{leftmargin=1.5em} is used to align labels with the start of lines.

\begin{verbatim}
\newcommand\enumfont{\bfseries}
\newenvironment{exenumerate}[1][1][]{%  
\setlist[enumerate]{font=\enumfont}  
\setlist[enumerate,1]{leftmargin=1.5em,  
itemsep=3ex plus 1ex minus 1ex,topsep=3ex plus 1ex minus 1ex}  
\setlist[enumerate,3]{noitemsep,nolistsep}  
\begin{enumerate}[#1]  
\end{enumerate}
\end{verbatim}

When using the \texttt{babel-french} package, \texttt{itemize} lists are altered to use the same dash label for each list level. These modifications are undone here to revert to the default \LaTeX{} \texttt{itemize} lists, including labels and spaces. This setting is done by the \texttt{frenchsetup} command, which should be invoked within the \texttt{\AtBeginDocument} command or immediately, depending on whether \texttt{exesheet} is loaded before or after \texttt{babel}.

\begin{verbatim}
\iftexesheet\setlist\fi
\ifdefined{frenchsetup}{\frenchsetup{StandardLists=true}}\fi
% must be executed here (and not at begin doc) if loaded after babel
\setlist\fi
\newcommand\labelenumone{\arabic{task}.}
\newcommand\labelenuma{\textup{(#\arabic{task})}}
\newcommand\refenuma{\textup{\arabic{task}}}
\def\exs@process@setlist{% must be executed at begin document
\iftexesheet\setlist\fi
\ifdefined{frenchsetup}{\frenchsetup{StandardLists=true}}\fi
\end{verbatim}
The \texttt{\texttt{NewTasksEnvironment}} command is part of the \texttt{tasks} package [4]. It enables the definition of the environments \texttt{tablenum1}, \texttt{tablenuma} and \texttt{tablitem}. Horizontal spacing is adjusted to ensure proper alignment with items in other \texttt{enumerate} (or \texttt{itemize}) environments.

\begin{verbatim}
\ifexesheet@setlist
  \settasks{label-format=\enumfont}
  \NewTasksEnvironment[label=\labelenumone, column-sep=1em, label-align=right, item-indent=1.5em, label-width=1em, label-offset=0.5em, after-item-skip=0.5ex plus 0.5ex minus 0.5ex}{tablenum1} \item (2)
  \NewTasksEnvironment[label=\labelenuma, ref=\refenuma, column-sep=1em, label-align=right, item-indent=2.15em, label-width=1.6em, label-offset=0.5em, after-item-skip=0.5ex plus 0.5ex minus 0.5ex]{tablenuma} \item (2)
\else
  \NewTasksEnvironment[label=\labelenumone, column-sep=1em, label-align=right, label-width=1em, label-offset=0.5em, after-item-skip=0.5ex plus 0.5ex minus 0.5ex]{tablenum1} \item (2)
  \NewTasksEnvironment[label=\labelenuma, ref=\refenuma, column-sep=1em, label-align=right, item-indent=2.15em, label-width=1.6em, label-offset=0.5em, after-item-skip=0.5ex plus 0.5ex minus 0.5ex]{tablenuma} \item (2)
\fi
\end{verbatim}

The starred environments \texttt{tablenuma*} and \texttt{tablitem*} are designed to be employed within an \texttt{enumerate} environment, precisely at the outset of an \texttt{item}, in order to achieve correct horizontal alignment. The length of \texttt{-1.667\baselineskip} has been tested with various font families and sizes. The alignment is generally good.

\begin{verbatim}
\newenvironment{tablenuma*}{\mbox{}\vspace{-1.667\baselineskip}\begin{tablenuma}}{\end{tablenuma}}
\newenvironment{tablitem*}{\mbox{}\vspace{-1.667\baselineskip}\begin{tablitem}}{\end{tablitem}}
\end{verbatim}
For items aligned by columns, we provide the \texttt{colsemnum} and \texttt{colsenum*} environments. The \texttt{multicol} package is required and an error message is produced if it has not been loaded. \texttt{\multicolsep} is the amount of space that should be added above or below the environment.

```
\newenvironment{colsenum*}[2][]{% 
  \ifexesheet@multicol \else \PackageError{exesheet}{The environments colsenum and colsenum* need the multicol package}{ Add \string\usepackage{multicol}\space in the preamble.} \fi 
  \setlength{\multicolsep}{2ex} 
  \begin{multicols}{#2} % #2 = number of columns 
  \begin{enumerate}[#1] % #1 = options of enumerate 
  \end{enumerate} 
  \end{multicols} 
%}

\newenvironment{colsenum}[2][]{% 
  \raggedcolumns % default is \flushcolumns 
  \begin{colsenum*}[#1]{#2} 
  \end{colsenum*} 
%}
```

The corresponding environments for itemize lists.

```
\newenvironment{colsitem*}[2][]{% 
  \ifexesheet@multicol \else \PackageError{exesheet}{The environments colsitem and colsitem* need the multicol package}{ Add \string\usepackage{multicol}\space in the preamble.} \fi 
  \setlength{\multicolsep}{2ex} 
  \begin{multicols}{#2} % #2 = number of columns 
  \begin{itemize}[#1] % #1 = options of itemize 
  \end{itemize} 
  \end{multicols} 
%}

\newenvironment{colsitem}[2][]{% 
  \raggedcolumns % default is \flushcolumns 
  \begin{colsitem*}[#1]{#2} 
  \end{colsitem*} 
%}
```

### 7.5 Questions and answers

The booleans \texttt{exesheet@questions} and \texttt{exesheet@answers} governs the visibility of their corresponding environments. These booleans are configured through the
output key option within the \exs@process@output macro.
\newboolean{exesheet@questions}\setboolean{exesheet@questions}{true}
\newboolean{exesheet@answers}\setboolean{exesheet@answers}{true}
\def\exs@process@output{
  \ifthenelse{\equal{\exesheet@output}{questions}}{
    \setboolean{exesheet@questions}{true}\setboolean{exesheet@answers}{false}\set@toclevel
  }{% else if
    \ifthenelse{\equal{\exesheet@output}{answers}}{
      \setboolean{exesheet@questions}{false}\setboolean{exesheet@answers}{true}\set@toclevel
    }{% else if
      \ifthenelse{\equal{\exesheet@output}{both}}{
        \setboolean{exesheet@questions}{true}\setboolean{exesheet@answers}{true}\set@toclevel
      }{% else
        \PackageWarning{exesheet}{Value \texttt{\exesheet@output} is not supported by ‘output’ option}\
      }
    }
  }\
}\end{questions}

questions We utilize the versions package developed by Uwe Lück [5], which introduces the macros \comment and \endcomment. These macros facilitate conditional displays, a technique also employed in the verbatim and version packages. Additionally, the notable codesection package offers the capability to enclose optional code between \BeginCodeSection{} and \EndCodeSection{⟨skip⟩} macros, both in the text body and the preamble. However, these macros cannot be used within an environment as we have done here with \comment and \endcomment. Several of our tests use the \LaTeX syntax \if\boolean{...}\fi since \comment and \endcomment can sometimes interfere with the \LaTeX structure \if ... \else ... \fi.

The two counters exe@ini and subpart@ini are employed in the subsequent \set@toclevel macro.
\newcounter{exe@ini}
\newcounter{subpart@ini}
\newenvironment{questions}{
  \ifthenelse{\boolean{exesheet@questions}}{%\%
    \setcounter{exe@ini}{\value{exercise}}\setcounter{subpart@ini}{\value{subpart}}\set@toclevel
  }{%}
}{\set@toclevel}

\newenvironment{answers}{
  \ifthenelse{\boolean{exesheet@questions}}{{}\{\endcomment}}
}{\set@toclevel}

answers The internal macro \set@toclevel calculates the title level (counter toc@level) to ensure correct typesetting of “Correction” at the start of an answers environment, when questions and answers are displayed together. It involves comparing the exercise and subpart counters with their values at the time of the questions environment call. The \@enumdepth counter indicates the current enumerate list
level (with 0 indicating outside of any list). The optional parameter of the `answers` environment permits the explicit specification of this title level.

\begin{verbatim}
\newcounter{@toclevel}
\newcommand{\set@toclevel}[1]{% #1 is the optional level
  \ifthenelse{\equal{#1}{}}{
    \ifthenelse{\value{exercise} > \value{exe@ini}}{
      \setcounter{@toclevel}{1}
    }{% else
      \ifthenelse{\equal{\the\@enumdepth}{0}}{
        % we're not in an enumerate environment
        \ifthenelse{\value{subpart} > \value{subpart@ini}}{
          \setcounter{@toclevel}{2}
        }{%}
        \setcounter{@toclevel}{3}
      }{%}
    }
    \setcounter{@toclevel}{#1}}
\end{verbatim}

The internal macro `\typeset@correctionname`, displays the term “Correction” at the appropriate level.

\begin{verbatim}
\definecolor{correctioncolor}{rgb}{0,0.2,0.6} % kind of dark blue
\newcommand{\correctionstyle}{\color{correctioncolor}}
\newcommand{\typeset@correctionname}{% #1 is the optional level
  \ifthenelse{\value{@toclevel} = 1}{% #1 is the optional level
    \section*{\correctionstyle\correctionname}
    \ifexesheet@exetoc
      \addcontentsline{toc}{section}{\correctionname}
    \fi
    \setcounter{exercise}{0}
  }{% else if
    \ifthenelse{\value{@toclevel} = 2}{% #1 is the optional level
      \subsection*{\correctionstyle\correctionname}
      \ifexesheet@exetoc
        \addcontentsline{toc}{subsection}{\correctionname}
      \fi
      \setcounter{subpart}{0}
    }{% else if
      \ifthenelse{\value{@toclevel} = 3}{% #1 is the optional level
        \subsubsection*{\correctionstyle\correctionname}
        \ifexesheet@exetoc
          \addcontentsline{toc}{subsubsection}{\correctionname}
        \fi
        \setcounter{subsubsection}{0}
      }{% else
        \par\textbf{\correctionstyle\correctionname}\par
      }
    }
  }
\end{verbatim}

Then we proceed to define the `answers` environment. It seems that the `tasks` package resets the color to black, therefore the `\color{correctioncolor}` options in `\settasks`.

\begin{verbatim}
\newenvironment{answers}[1][% #1 is the optional level
  \ifthenelse{\boolean{exesheet@answers}}{% #1 is the optional level
    \section*{\correctionstyle\correctionname}
    \ifexesheet@exetoc
      \addcontentsline{toc}{section}{\correctionname}
    \fi
    \setcounter{exercise}{0}
  }{% else if
    \ifthenelse{\value{@toclevel} = 2}{% #1 is the optional level
      \subsection*{\correctionstyle\correctionname}
      \ifexesheet@exetoc
        \addcontentsline{toc}{subsection}{\correctionname}
      \fi
      \setcounter{subpart}{0}
    }{% else if
      \ifthenelse{\value{@toclevel} = 3}{% #1 is the optional level
        \subsubsection*{\correctionstyle\correctionname}
        \ifexesheet@exetoc
          \addcontentsline{toc}{subsubsection}{\correctionname}
        \fi
        \setcounter{subsubsection}{0}
      }{% else
        \par\textbf{\correctionstyle\correctionname}\par
      }
    }
  }
\end{verbatim}
When placing \correctionstyle before \subsubsection in the answers environment (as in the case of \typeset@correctionname), the preceding vertical space may become too wide.

The \answerspace macro leaves blank space to allow students for writing their answers on the provided paper following a suggestion by Maxime Chupin.
The `correct` option needs the `schooldocs` package. It triggers the `\correct` macro of `schooldocs` which adds the content of `\correctname` in the title of the document. Here the option conditional triggers `\correct` only if `output=answers` or both.

```
\def\exs@process@correct{
  \ifthenelse{\equal{\exesheet@correct}{false}}{% do nothing
    \@ifpackageloaded{schooldocs}{
      \ifthenelse{\equal{\exesheet@correct}{true}}{
        \correct}
      \else\fi
    }{% else
      \PackageWarningNoLine{exesheet}{The ‘correct’ option requires
    the ‘schooldocs’ package to be loaded}
    }%}
  %}
}
```

### 7.6 Marking scheme options processing

The options `display`, `marginpos`, `marginwidth` and `noteragged` are handled using the following internal commands.

The `display` key option determines the value of the two booleans `exesheet@pts` and `exesheet@notes`. The `exesheet@pts` boolean controls the display of the content of `\pts` and optional arguments of `\note`, while the `exesheet@notes` boolean controls mandatory arguments of `\note`.

```
\newboolean{exesheet@pts}
\newboolean{exesheet@notes}
\def\exs@process@display{
  \ifthenelse{\equal{\exesheet@display}{pts}}{{
    \setboolean{exesheet@pts}{true}
    \setboolean{exesheet@notes}{false}
  }{% else if
    \ifthenelse{\equal{\exesheet@display}{notes}}{{
      \setboolean{exesheet@pts}{true}
      \setboolean{exesheet@notes}{true}
    }{% else if
      \ifthenelse{\equal{\exesheet@display}{none}}{{
        \setboolean{exesheet@pts}{true}
        \setboolean{exesheet@notes}{true}
      }{% else
        \PackageWarning{exesheet}{Value ‘\exesheet@display’
      is not supported by ‘display’ option}
    }%}
  }{% else
    \PackageWarning{exesheet}{Value ‘\exesheet@display’
}}%}
```

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\texttt{\texttt{\textbackslash exs@process@marginpos}} The \texttt{marginpos} key option takes the values \texttt{left} (the default value) or \texttt{right} (or \texttt{inner} and \texttt{outer}). In practice, \texttt{inner} is equivalent to \texttt{left}, but in two-sided mode, the values \texttt{left} or \texttt{right} are converted to \texttt{outer} (which is then the default value for two-sided mode).

\begin{verbatim}
\newboolean{exesheet@leftmargin}
\def\exs@process@marginpos{
  \ifthenelse{\equal{\exesheet@marginpos}{left}}{
    \if@twoside%
      \PackageWarningNoLine{exesheet}{The default ‘marginpos’
        option \MessageBreak
        for two-sided documents is ‘outer’.'\MessageBreak
        To change the side, use ‘inner’}
      \def\exesheet@marginpos{outer}
      \setboolean{exesheet@leftmargin}{false}
      \normalmarginpar
    \else% default
      \setboolean{exesheet@leftmargin}{true}
      \reversemarginpar
    \fi
  }{% else if
    \ifthenelse{\equal{\exesheet@marginpos}{right}}{
      \if@twoside%
        \PackageWarningNoLine{exesheet}{The default ‘marginpos’
          option \MessageBreak
          for two-sided documents is ‘outer’.'\MessageBreak
          To change the side, use ‘inner’}
        \def\exesheet@marginpos{outer}
        \fi
      \setboolean{exesheet@leftmargin}{false}
      \normalmarginpar
    }{% else if
      \ifthenelse{\equal{\exesheet@marginpos}{inner}}{
        \setboolean{exesheet@leftmargin}{true}
        \reversemarginpar
    }{% else
      \PackageWarningNoLine{exesheet}{The value ‘\exesheet@marginpos’
        is not supported by the ‘marginpos’ option}
    }
  }
}
\end{verbatim}

\texttt{\texttt{\textbackslash exs@process@marginwidth}} The \texttt{marginwidth} option adjusts the ratio between left and right margins based on what needs to be displayed in the margin (points only or full notes)\textsuperscript{9}. When \texttt{display=notes}, the additional length of \texttt{1 in} corresponds to the default free space to the left of \texttt{\oddsidemargin}.

\textsuperscript{9}To ensure the accurate effect on the margin ratio, this option is processed at the beginning of the document, after other commands that could potentially alter the page geometry.
The macros \standardmarginwidthfactor and \largemarginwidthfactor represent the ratios between the total margin width and \marginparwidth.

\def\standardmarginwidthfactor{0.6}
\def\largemarginwidthfactor{0.8}

\newcommand*{\leftnotemarginwidth}[1]{
  \setlength{\marginparwidth}{\oddsidemargin}
  \addtolength{\marginparwidth}{1in}
  \addtolength{\marginparwidth}{-\marginparsep}
  \setlength{\marginparwidth}{#1\marginparwidth}
}

\newcommand*{\rightnotemarginwidth}[1]{
  \setlength{\marginparwidth}{\paperwidth}
  \addtolength{\marginparwidth}{-\textwidth}
  \addtolength{\marginparwidth}{-\oddsidemargin}
  \addtolength{\marginparwidth}{-\marginparsep}
  \addtolength{\marginparwidth}{-1in}
  \setlength{\marginparwidth}{#1\marginparwidth}
}

\def\exesheet@smallmargins{
  \geometry{hmarginratio=1:1}
  \leftnotemarginwidth{\standardmarginwidthfactor}
}

\def\exesheet@standardmargins{
  \ifexesheet@leftmargin
    \geometry{hmarginratio=3:2}
    \leftnotemarginwidth{\standardmarginwidthfactor}
  \else
    \geometry{hmarginratio=2:3}
    \rightnotemarginwidth{\standardmarginwidthfactor}
  \fi
}

\def\exesheet@largemargins{
  \ifexesheet@leftmargin
    \geometry{hmarginratio=3:1}
    \leftnotemarginwidth{\largemarginwidthfactor}
  \else
    \geometry{hmarginratio=1:3}
    \rightnotemarginwidth{\largemarginwidthfactor}
  \fi
}

\def\exs@process@marginwidth{
  \ifthenelse{\equal{\exesheet@marginwidth}{standard}}{
    \ifthenelse{\equal{\exesheet@display}{none}}{
      \if@twoside
        \exesheet@standardmargins
      \else
        \exesheet@smallmargins
      \fi
    }{% else display=pts or display=notes
      \exesheet@standardmargins
    }
  }{% else
    \exesheet@standardmargins
  }
}
For a two-sided document, the geometry package does not correctly set the default width of the margin paragraph; it’s too wide. Therefore, we provide an explicit setting here, which is useful when marginwidth=unset. Otherwise, the setting is handled by the marginwidth key option.

\exs@process@noteragged The noteragged option can take one of the following values: left, right, center, justify or twoside. When working with a two-sided document, marginpar can be used with an optional parameter to distinguish left from right contents. In this context, we employ \noteraggedleft and \noteraggedright instead of \noteragged. The ragged2e package by Martin Schröder [8] offers the commands \RaggedLeft, \RaggedRight, \Centering, and \justifying. These commands yield better results compared to the standard \raggedleft, \raggedright and \centering commands. Margin paragraphs are justified by default in \LaTeX.
The scale control option relies on calculations with *lengths*, which need to have a *global* scope.

For questions, assigned points will be added in \texttt{\sum@pts}, while for exercises, points accumulate in \texttt{\sum@exe}. These lengths are compared against \texttt{\exe@total} and \texttt{\sheet@total}. The \texttt{\exe@check} macro validates the calculations of the previous exercise when triggered by \texttt{\points}, \texttt{\totalex} or \texttt{\totalpoints} macros. Percent symbols at end of lines are necessary to prevent unwanted spaces. \texttt{\exe@check} is also invoked within \texttt{\exs@process@checkpts} at the document’s end for a final check on the last exercise.
\def\exe@check{% 
\ifthenelse{\lengthtest{\sum@pts = 0pt}}{% 
% do not check, no points or first exercise begins 
\ifthenelse{\equal{\exe@currentlabel}{none}}{}{% 
\PackageWarningNoLine{exesheet}{\exe@currentlabel:
the\exe@total}}}% 
}% 
\ifthenelse{\lengthtest{\exe@total = \sum@pts}}{% 
\PackageWarningNoLine{exesheet}{\exe@currentlabel:
Sum of points \the\exe@total space is valid}% 
}% 
\PackageWarningNoLine{exesheet}{\exe@currentlabel:
Sum of points is \the\sum@pts space
instead of \the\exe@total}% 
\setboolean{scale@valid}{false}% 
}% 
}

\def\exs@process@checkpts{
\ifexesheet@checkpts
\ifthenelse{\lengthtest{\sheet@total = 0pt}}{
\PackageWarningNoLine{exesheet}{Option checkpts is true,
but \string\totalsheet space is missing
in the preamble. \MessageBreak
See documentation}}{}
\global\sum@exe=0pt
\global\exe@total=0pt
\global\sum@pts=0pt
\setboolean{scale@valid}{true}
\AtEndDocument{% final checking (global)
\ifthenelse{\equal{\exe@currentlabel}{none}}{
\ifthenelse{\lengthtest{\sum@pts = 0pt}}{
\PackageWarningNoLine{exesheet}{checkpts:
No points displayed}}{% 
\PackageWarningNoLine{exesheet}{checkpts:
Total:
Sum of points \the\sheet@total space is valid}}{% 
\PackageWarningNoLine{exesheet}{checkpts:
Total:
Sum of points is \the\sum@pts space
instead of \the\sheet@total}}}% 
}%
\ifthenelse{\lengthtest{\sheet@total = \sum@exe}}{
\PackageWarningNoLine{exesheet}{Total:
No points displayed}}{% 
\PackageWarningNoLine{exesheet}{Total:
No points displayed}}
\ifthenelse{\lengthtest{\sheet@total = \sum@exe}}{% 
\PackageWarningNoLine{exesheet}{Total:} {}}
Sum of points \the\sheet@total\space is valid}
}{
\PackageWarningNoLine{exesheet}{Total:
Sum of points is \the\sum@exe\space instead of \the\sheet@total}
\setboolean{scale@valid}{false}
}
\ifthenelse{\boolean{scale@valid}}{
\PackageWarningNoLine{exesheet}{Marking scheme checked without errors}
}{
\PackageWarningNoLine{exesheet}{Marking scheme checked with ERRORS! See above}
}
}
\fi

7.7 Marking scheme commands

The \check@points macro, used by \points and \totalexe, triggers the marking scheme control (with \exe@check defined above) and sets label and lengths for the next exercise.

\newcommand*{\check@points}[1]{
\ifexesheet@checkpts%
\exe@check% checks the previous exercise
\gdef\exe@currentlabel{\exe@label}% for the upcoming exercise
\global\sum@pts=0pt%
\global\exe@total=#1pt%
\global\advance\sum@exe by #1pt%
\fi%}
}

\points
\definecolor{pointscolor}{named}{red}
\newcommand[\pointsstyle]{%\small\mdseries\sffamily\color{pointscolor}\fbox}
\newcommand*[\points][1]{%\ifthenelse{\boolean{exesheet@questions}}{\hfill \pointsstyle{#1~%\ifthenelse{\lengthtest{#1pt < 2pt}}{\pointname}{\pointsname}}%\check@points{#1}%}{}}

To prevent spaces between the \fbox and its inner text, percent symbols are necessary. The test #1 < 2 doesn’t work with decimal numbers without \lengthtest, but it works with lengths.
\definecolor{ptscolor}{named}{red}
\newcommand\ptsstyle[1]{\footnotesize\centering\sffamily\color{ptscolor}(#1)}
\newcommand*\ptsmark[1]{\ifthenelse{\lengthtest{#1 pt < 2 pt}}{#1 \ptname}{#1 \ptsname}}
\newcommand*\pts[1]{\ifexesheet@pts\mbox{}\marginpar{\hspace{0pt}\ptsstyle\ptsmark{#1}}\ifexesheet@checkpts\global\advance\sum@pts by #1 pt\fi\fi\ignorespaces}

\newcommand\markingstyle[1]{\footnotesize\sffamily\centering\color{markingcolor}\textbf{#1}}
\newlength{\ptsboxlength}
\setlength{\ptsboxlength}{3.1em}
\cornersize{1}
\newcommand*\totalexe[1]{\ifexesheet@pts\mbox{}\marginpar{\hspace{0pt}\markingstyle{\ovalbox{\makebox[\ptsboxlength]{\ptsmark{#1}}}}}\check@points{#1}\fi\ignorespaces}
\newcommand*\totalsheet[1]{\global\sheet@total=#1 pt}

\note The booleans \texttt{exesheet@pts} and \texttt{exesheet@notes} control the display of marginal notes. If \texttt{exesheet@pts} is set to \texttt{false}, \texttt{exesheet@notes} will be ignored. \texttt{\noindent} is required when using \texttt{\justifying} from the \texttt{ragged2e} package \cite{ragged2e}. Within the \texttt{\note@marginpar} macro, enclosing \texttt{\markingstyle} in double braces helps prevent unintended formatting within the mandatory argument of \texttt{\note}. A vicious error occurs when using an \texttt{if ... \fi} structure instead of \texttt{\ifthenelse} inside \texttt{\note@marginpar} (but only if @twoside is \texttt{true}).
\definecolor{notecolor}{rgb}{0.0, 0.4, 0.0} % kind of dark green
\newcommand{\notestyle}[1]{\footnotesize\sffamily\color{notecolor} #1}
\newcommand{\note@marginpar}[1]{%
  \if@twoside%
    \marginpar{\noteraggedleft #1}{\noteraggedright #1}%
  \else%
    \marginpar{\noteragged #1}%
  \fi%
}
\newcommand{\@note}[2]{%
  \ifexesheet@pts%
    \mbox{}
    \note@marginpar{%
      \ifthenelse{\equal{#1}{}}{}{{%
        \noindent\hspace{0pt}\markingstyle{#1}\%}}%
      \ifthenelse{\boolean{exesheet@notes}}{%
        \noindent\hspace{0pt}\notestyle #2\%}{%}
    }%
    \ifexesheet@checkpts%
    \global\advance\sum@pts by #1pt%
  \else%
    \fi%
  \fi%
\ignorespaces
}
\newcommand{\@@note}[1]{%
  \ifexesheet@pts%
    \mbox{}
    \marginpar{\noindent\hspace{0pt}\markingstyle{#1}}%
  \else%
    \fi%
\ignorespaces
}
\newcommand{\note}{\@ifstar{\@@note}{\@note}}
\totalpoints
\newcommand{\totalpoints}{%
  \ifthenelse{\boolean{exesheet@pts}}{\totalexe}{\points}}

\totalpoints

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