Using the exam document class

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This is the user's guide for version 2.5 of the `exam` document class.

Contents

1   Introduction

The file `exam.cls` provides the `exam` document class, which attempts to make it easy for even a LaTeX novice to prepare exams. Specifically, `exam.cls` sets the page layout so that there are one inch margins all around (no matter what size paper you're using) and provides commands that make it easy to format questions, create flexible headers and footers, change the margins, and create grading tables. In more detail:

- The class will automatically format and number the questions, parts of questions, subparts of parts, and subsubparts of subparts (see sections **??** and **??**).

- You can include the point value of each question (or part, or subpart, or subsubpart), with your choice of having the point values printed at the beginning of the text of the question, opposite that in the left margin, opposite that in the right margin, or in the right margin opposite the end of the question (see section **??**).

- The class will add up the total points for each question (and all of its parts, subparts, and subsubparts) and the total points on each page, and make those totals available in macros (see sections **??**, **??** and **??**).

- You can have the class print a grading table, indexed either by question number or by page number (see section **??**).

- You specify the header in three parts: One part to be left justified, one part to be centered, and one part to be right justified, and one or all of these can be omitted (see section **??**).

- The footer is also specified in three parts: Left justified, centered, and right justified (see section **??**).

- The header and footer for the first page can be different from the ones used on other pages (see sections **??**, **??**, **??**, and **??**).

- Both headers and footers can contain more than one line. To accommodate headers and footers with several lines, simple commands are provided to enlarge the part of the page devoted to the header and/or footer, and these commands can give one amount of space on the first page and a different amount of space on all other pages (see section **??**).

- Macros are defined to enable you to state the total number of pages in the exam (see section **??**) and to change the header and/or footer that appears on the last page of the exam (see section **??**).

- Macros are defined so that the headers and footers can vary depending on whether the current page begins a new question or continues a question that started on an earlier page (and, if one continues onto the current page, to say what the number of that question is). Macros are also defined so that the headers and footers can vary depending on whether a question is complete on the current page or continues on to the next page (and, if one continues, to say what the number of that question is) (see section **??**).

- You can have a horizontal rule at the base of the header and/or at the top of the footer (see section **??**).

- The exam can begin with one or more cover pages, which are numbered separately from the main pages of the exam and which can have headers and footers different from the ones in the main pages of the exam (see section **??**).

- You can include solutions in your LaTeX file and have these solutions either printed or ignored (or replaced automatically by space in which the students can write their answers) depending on a single command (see section **??**, section **??**, and section **??**).

The latest version of `exam.cls` (possibly a beta test version) should always be available at `http://www-math.mit.edu/~psh/`.

1.1 License

- This work may be distributed and/or modified under the conditions of the LaTeX Project Public License, either version 1.3 of this license or (at your option) any later version. The latest version of this license is in `http://www.latex-project.org/lppl.txt` and version 1.3 or later is part of all distributions of LaTeX version 2003/12/01 or later.

- This work has the LPPL maintenance status "author-maintained".

- This work consists of the files `exam.cls` and `examdoc.tex`.

2 Simple instructions for a basic exam

Producing a basic exam with the `exam` document class is fairly easy. After you learn to do that, you can read the parts of this user's guide that describe how to customize whatever you want to change.

2.1 The `\documentclass` command

To use the `exam` document class, your `\documentclass` command should be

`\documentclass[addpoints]{exam}`

or, if you want to use 12 point type,

`\documentclass[addpoints,12pt]{exam}`

There are other options; for the full story, see section **??**.

2.2 Asking for the student's name

If you'll be leaving space for the answers on the question pages (see sections **??** and **??**), then you'll probably also want to leave space for the student's name. If you type

```
\begin{center}
  \fbox{\fbox{\parbox{5.5in}{\centering
      Answer the questions in the spaces provided on the
      question sheets.  If you run out of room for an answer,
      continue on the back of the page.}}}
\end{center}

\vspace{0.1in}

\makebox[\textwidth]{Name and section:\enspace\hrulefill}

\vspace{0.2in}

\makebox[\textwidth]{Instructor's name:\enspace\hrulefill}
```

after the \begin{document} command and before the \begin{questions} command (see section **??**), then you'll get

> Answer the questions in the spaces provided on the question sheets. If you
> run out of room for an answer, continue on the back of the page.

Name and section: _____

Instructor's name: _____

2.3   Asking questions

Once you've typed \begin{document} and (if the students will be writing their answers on the question pages) asked for the student's name (see section **??**), you can list the questions on the exam in a questions environment. You begin each question with a \question command, which is optionally followed by a number of points inside of square brackets. For example, if you type

```
\begin{questions}

\question[10]
Why is there air?

\question[15]

How much wood would a woodchuck chuck if a woodchuck could chuck
wood?

\question[10] Compute $\displaystyle\int_0^1 x^2 \, dx$.
\end{questions}
```

then you'll get

1. (10 points) Why is there air?

2. (15 points) How much wood would a woodchuck chuck if a woodchuck could chuck wood?

3. (10 points) Compute $\displaystyle\int_0^1 x^2\, dx$.

   As the above example illustrates, you can leave blank lines between the \question command and the actual beginning of the question, or before the first \question command in the environment, and they will be ignored. The point values are entirely optional; if you omit the point values, you should also omit the square brackets containing them.

If you give the command `\marksnotpoints`, then the words "point" and "points" will be replaced by the words "mark" and "marks". There are many other customizations possible for the points, including using a different language, changing the way the points are printed, and by having them printed in one of the margins. For the full story, see section **??**.

2.4   Questions with parts, and subparts, and subsubparts

If you want to create a question with parts, you use a `parts` environment and begin each part with the command `\part`. The `parts` environment can be at the beginning of a question or after some text that begins the question. (There are also `subparts` and `subsubparts` environments; for the full details, see section **??**.) For example, if you type

```
\begin{questions}
\question[10]
Why is there air?

\question
What if there were no air?

\begin{parts}
\part[5]
Describe the effect on the balloon industry.

\part[5]
Describe the effect on the aircraft industry.
\end{parts}

\question[20]

\begin{parts}
\part
Define the universe.  Give three examples.

\part
If the universe were to end, how would you know?

\end{parts}


\end{questions}
```

then you'll get

1. (10 points) Why is there air?

2. What if there were no air?

(a) (5 points) Describe the effect on the balloon industry.

(b) (5 points) Describe the effect on the aircraft industry.

3. (20 points) (a) Define the universe. Give three examples.

(b) If the universe were to end, how would you know?

The above example illustrates several things:

- Parts of a question should be put into a `parts` environment.

- If a question begins with a `parts` environment, then the first part will appear on the same line with the question number.

- You can leave blank lines before and after the `\part` command, and they will be ignored.

- You can assign points either to the question or to the parts of a question.

2.5   Leaving space for the answers

To leave blank space after a question you use the `\vspace` command, and you end a page with the `\newpage` command. For example, if you wanted to leave 3 inches of space after the first question and 2 inches of space after each of the parts of the second question, your `questions` environment would contain the following:

```
\question[10]
Why is there air?

\vspace{3in}

\question
What if there were no air?

\begin{parts}
\part[5]
Describe the effect on the balloon industry.
\vspace{2in}

\part[5]
Describe the effect on the aircraft industry.
\vspace{2in}
\end{parts}
\newpage
```

If you want to equally distribute the space on a page among several questions (or parts, or subparts, or subsubparts), you should type

$$\texttt{\textbackslash vspace\{\textbackslash stretch\{1\}\}}$$

after each of the questions (or parts, etc.) and end the page with `\newpage`. If you'd like one of those questions to receive twice as much space as each of the others, then follow that one question with `\vspace{\stretch{2}}` and follow each of the others with `\vspace{\stretch{1}}`. (You can use any decimal number for the `\stretch` value. For example, `\vspace{\stretch{1.5}}` will allocate 1.5 times the amount of space allocated by `\vspace{\stretch{1}}`.)

In addition to leaving blank space, it's also possible to leave lined space, dotted lined space, or an empty box. For the full story, see section **??**.

2.6   Headers and footers

To produce headers and footers, you give the command

$$\texttt{\textbackslash pagestyle\{headandfoot\}}$$

in the preamble (i.e., after the `\documentclass` command and before the `\begin{document}` command), followed by the commands that say what will be in the headers and footers. Headers and footers each have three parts: One part on the left, one centered part, and one part on the right, and any of these can be empty.

The headers and footers are determined by the commands

`\firstpageheader`	for the header on the first page,
`\firstpagefooter`	for the footer on the first page,
`\firstpageheadrule`	to put a horizontal rule in the head of the first page,
`\firstpagefootrule`	to put a horizontal rule in the foot of the first page,
`\runningheader`	for the header after the first page,
`\runningfooter`	for the footer after the first page
`\runningheadrule`	to put a horizontal rule in the head after the first page, and
`\runningfootrule`	to put a horizontal rule in the foot after the first page.

For example, to have the header

Math 115   First Exam   July 4, 1776

on the first page, the header

Math 115   First Exam, Page 2 of 5   July 4, 1776

on all pages after the first, and no footer on any page, give the commands

```
\pagestyle{headandfoot}
\runningheadrule
\firstpageheader{Math 115}{First Exam}{July 4, 1776}
\runningheader{Math 115}
             {First Exam, Page \thepage\ of \numpages}
             {July 4, 1776}
\firstpagefooter{}{}{}
\runningfooter{}{}{}
```

For another example, to have the header

on the first page, no header on the pages after the first, no footer on the first page, and the footer

on all pages after the first, give the commands

```
\pagestyle{headandfoot}
\firstpageheader{Math 115}{First Exam}{July 4, 1776}
\runningheader{}{}{}
\firstpagefooter{}{}{}
\runningfooter{Math 115}{First Exam}{Page \thepage\ of \numpages}
\runningfootrule
```

Sections **??** through **??** contain many other examples of headers and footers, and the full explanation of the commands for headers and footers is in sections **??**–**??**.

3   The \documentclass command

To use the exam document class, you should specify exam as the required argument to your \documentclass command, as in

$$\text{\documentclass\{exam\}}$$

or, e.g., if you want to use 12 point type,

$$\text{\documentclass[12pt]\{exam\}}$$

There are two possible optional arguments that are specific to the exam document class: addpoints and solutions. Most documents that use the exam document class should use the option addpoints (see section **??**); the option answers is used when you want to print solutions to the questions (see section **??**).

3.1   The option addpoints

The \documentclass option addpoints, used as in

$$\text{\documentclass[addpoints]\{exam\}}$$

or

$$\text{\documentclass[12pt,addpoints]\{exam\}}$$

enables the commands that add up the points (see sections **??**, **??**, **??**, and **??**) and that produce grading tables and point tables (see sections **??** and **??**). This is an option, rather than the default, mainly for the sake of maintaining backward compatibility; most documents that use the `exam` document class should use this option. The only reason *not* to use the `addpoints` option is that this option creates an error if you include any words in an argument that assigns points to a question (see section **??**). If `addpoints` is not in effect you can put whatever you want in the argument for the points, but if `addpoints` *is* in effect then the argument that contains the points must contain only digits and the command `\half` (see section **??**).

You can also turn `addpoints` on and off wherever you like in the exam by using the commands

<div align="center">

`\addpoints`
`\noaddpoints`

</div>

Using the document class option `addpoints` is equivalent to giving the command `\addpoints` at the beginning of the exam.

3.2 The option `answers`

If you will be typing solutions into the exam (see sections **??**, **??**, and **??**) and you'd like the solutions to be printed on the next run of LaTeX, you should include the document class option `answers`, as in

<div align="center">

`\documentclass[answers]{exam}`

</div>

or

<div align="center">

`\documentclass[answers,12pt]{exam}`

</div>

or

<div align="center">

`\documentclass[12pt,addpoints,answers]{exam}`

</div>

Using the document class option `answers` is equivalent to giving the command `\printanswers` at the beginning of the exam (see section **??**). The effect of this is that

- the contents of the environments

<div align="center">

`solution`,
`solutionorbox`,
`solutionorlines`, and
`solutionordottedlines`

</div>

  (see section **??**) will be printed on the next run of LaTeX,

- any choices of a `choices`, `oneparchoices`, `checkboxes`, or `oneparcheckboxes` environment (see section **??**) that are created using a `\CorrectChoice` command (see section **??**) instead of a `\choice` command will be printed with emphasis as determined by the argument of the most recent `\CorrectChoiceEmphasis` command (which by default is `\bfseries`), and

- any `\answerline` commands (see section **??**) that include an optional argument containing the answer (see section **??**) will have the answer printed on the answer line.

4   Questions and points

To create questions, you use a `questions` environment (see section **??**); each question is begun with a `\question` command, which takes an optional argument to assign some number of points to the question (see section **??**). The questions are numbered automatically. Point values can include half points (see section **??**).

If you want a question to have several parts, you use a `parts` environment (see section **??**); each part is begun with a `\part` command, which takes an optional argument to assign some number of points to the part (see section **??**). The parts are numbered automatically. Similarly, parts can have subparts, and subparts can have subsubparts (see section **??**).

The points for a question (or part, or subpart, or subsubpart) appear by default at the beginning of the question (or part, etc.), but there are commands to have the points appear instead in either the left margin or in the right margin (see section **??** and section **??**). The formatting of the points can also be customized (see sections **??**, **??**, **??**, and **??**). It's also possible to have questions (or parts, etc.) that are worth "bonus points", which are added up separately from the non-bonus points (see section **??**).

4.1   Questions

To type the questions on the exam you use the `questions` environment. Each question is then begun with the command `\question`, and the questions are numbered automatically.

For example, if you type

```
\begin{questions}

\question
Why is there air?

\question

How much wood would a woodchuck chuck if a woodchuck could chuck
wood?

\question Compute $\displaystyle\int_0^1 x^2 \, dx$.
\end{questions}
```

then you'll get

1. Why is there air?

2. How much wood would a woodchuck chuck if a woodchuck could chuck wood?

3. Compute $\displaystyle\int_0^1 x^2\,dx$.

As the above example illustrates, you can leave blank lines between the `\question` command and the actual beginning of the question, or before the first `\question` command in the environment, and they will be ignored.

4.2   Questions with parts and subparts (and subsubparts)

If you want a question to have several parts, then you use the `parts` environment. For example, if you type

```
\begin{questions}
\question
Why is there air?

\question
What if there were no air?

\begin{parts}
\part
Describe the effect on the balloon industry.

\part
Describe the effect on the aircraft industry.
\end{parts}

\question

\begin{parts}
\part
Define the universe.  Give three examples.

\part
If the universe were to end, how would you know?

\end{parts}


\end{questions}
```

then you'll get

1. Why is there air?

2. What if there were no air?
    (a) Describe the effect on the balloon industry.
    (b) Describe the effect on the aircraft industry.

3. (a) Define the universe. Give three examples.
    (b) If the universe were to end, how would you know?

The above example illustrates several things:

- Parts of a question should be put into a `parts` environment.

- If a question begins with a `parts` environment, then the first part will appear on the same line with the question number.

- You can leave blank lines before and after the `\part` command, and they will be ignored.

There is also a `subparts` environment, and even a `subsubparts` environment, and they work just as you would expect. For example, if you type

```
\begin{questions}
\question
\begin{parts}
\part
What do you do with a drunken sailor?

\part
Is your answer different if it is before noon?

\end{parts}

\question
This is the second question.

\begin{parts}
\part
This is a part.

\part
This is also a part.
```

```
\begin{subparts}
\subpart
This is a subpart.

\subpart
This is a periscope.

\subpart
This is a pair of diving planes.

\subpart
\begin{subsubparts}
\subsubpart
This is a subsubpart.

\subsubpart
The lower surface of a diving plane?

\subsubpart
The ocean floor, perhaps?

\end{subsubparts}
\end{subparts}

\part
It's sad to be apart.

\end{parts}

\question
\begin{parts}
\part
\begin{subparts}
\subpart
This is a subpart.

\subpart
This is another subpart.
\end{subparts}
\part
This is another part.

\end{parts}
```

```
\end{questions}
```

then you'll get

1. (a) What do you do with a drunken sailor?
   (b) Is your answer different if it is before noon?

2. This is the second question.
   (a) This is a part.
   (b) This is also a part.
       i. This is a subpart.
       ii. This is a periscope.
       iii. This is a pair of diving planes.
       iv. α) This is a subsubpart.
           β) The lower surface of a diving plane?
           γ) The ocean floor, perhaps?
   (c) It's sad to be apart.

3. (a)   i. This is a subpart.
         ii. This is another subpart.
   (b) This is another part.

The numbers and letters used to number questions, parts, subparts, and subsubparts can be customized; see section **??**.

4.3   Point values for the questions

Each of the commands `\question`, `\part`, `\subpart`, and `\subsubpart` takes an optional argument, which is the number of points for that question, part, subpart, or subsubpart. The default setup is that

- the point value is printed at the beginning of the question (or part, or subpart, or subsubpart) (this can be changed to printing in either the left or right margins on the first line of the question or in the right margin at the end of the question; see section **??** and section **??**), and

- the point value is enclosed in parentheses (this can be changed to either square brackets or a box; see section **??**).

Both of these things can be further customized; see section **??** and section **??**.

4.3.1   Where the points will be printed

The default is that the point value will be inserted at the beginning of the question (or part, or subpart, or subsubpart) in parentheses, but

- the command \pointsinmargin will cause the point values to be set in the left margin,

- the command \pointsinrightmargin will cause the point values to be set in the right margin, and

- the commands \nopointsinmargin and \nopointsinrightmargin are equivalent, and either of them will revert to the default situation.

All of these print the point values on the first line of the question (or part, or subpart, or subsubpart). There is also a way to print the point values on the *last* line of the question (or part, etc.); for this, see section **??**.

For example, if you type

```
\begin{questions}
\question[20]
Why is there air?


\question
What if there were no air?

\begin{parts}
\part[10]
Describe the effect on the balloon industry.

\part[10]
Describe the effect on the aircraft industry.
\end{parts}

\end{questions}
```

then, with the default setup, you'll get

1. (20 points) Why is there air?

2. What if there were no air?
    (a) (10 points) Describe the effect on the balloon industry.
    (b) (10 points) Describe the effect on the aircraft industry.

(To change the word "points", see the commands described in section **??**.)

If you give the command \pointsinmargin, then the above input will produce instead

(20)   1. Why is there air?

    2. What if there were no air?

(10)   (a) Describe the effect on the balloon industry.

(10)   (b) Describe the effect on the aircraft industry.

(To have a word (e.g., "points", or "%") inside the parentheses with the point values, see the `\marginpointname` command in section **??**.)

    If you give the command `\pointsinrightmargin`, then the above input will produce instead

1. Why is there air?   (20)

2. What if there were no air?

    (a) Describe the effect on the balloon industry.   (10)

    (b) Describe the effect on the aircraft industry.   (10)

4.3.2   Printing the points at the end of the question

Instead of having the point value of a question (or part, or subpart, or subsubpart) printed on the first line of a question, you can have it printed in the right margin opposite the *last* line, or even opposite a blank line following the paragraph. This is done with the

$$\text{\textbackslash pointsdroppedatright} \quad \text{and} \quad \text{\textbackslash droppoints}$$

commands.

    If you give the command

$$\text{\textbackslash pointsdroppedatright}$$

then point values are not printed until you give the command `\droppoints` (and they're not printed at all if you don't give the command `\droppoints`). The only exception to this rule is that if you've given a `\qformat` command (see section **??**), then question number lines are printed as specified by the argument to the `\qformat` command even if you have given the command `\pointsdroppedatright`

    The command `\droppoints` should be given only at the end of a paragraph or between paragraphs; if you give it within a paragraph, it causes the paragraph to end. `\droppoints` prints the point value in the right margin, formatted as it is when you give the command `\pointsinrightmargin`, except that the points appear opposite the last line of the paragraph (or, if the command `\droppoints` is given between paragraphs, then additional vertical space is left between the paragraphs and the points are printed opposite the blank space). The formatting can be changed by giving the commands `\bracketedpoints`, `\boxedpoints`, or `\marginpointname` (see section **??**) just as if `\pointsinrightmargin` were in effect. The command `\droppoints` actually works this way even if one of the commands

$$\text{\textbackslash nopointsinmargin,} \quad \text{\textbackslash pointsinmargin,} \quad \text{or} \quad \text{\textbackslash pointsinrightmargin}$$

is in effect, but if you use it that way the points will appear twice on the page, which is probably not what you want.

For example, if you give the command `\pointsdroppedatright` and then type

```
\begin{questions}
\question[10]
Describe the implications of the Michelson-Morley ink drop experiment
for the use of punctuation marks such as colons and semicolons that
require multiple drops of ink.
\droppoints

\question[10]
Prove that the second dual of a finite dimensional real vector space
is naturally isomorphic to the given vector space, except when the
weapon chosen is a single shot pistol.\droppoints

\end{questions}
```

then you'll get

1. Describe the implications of the Michelson-Morley ink drop experiment for the use of punctuation marks such as colons and semicolons that require multiple drops of ink. (10)

2. Prove that the second dual of a finite dimensional real vector space is naturally isomorphic to the given vector space, except when the weapon chosen is a single shot pistol. (10)

and if you type

```
\begin{questions}
\question[10]
Describe the implications of the Michelson-Morley ink drop experiment
for the use of punctuation marks such as colons and semicolons that
require multiple drops of ink.

\droppoints

\question[10]
Prove that the second dual of a finite dimensional real vector space
is naturally isomorphic to the given vector space, except when the
weapon chosen is a single shot pistol.

\droppoints
\end{questions}
```

then you'll get

1. Describe the implications of the Michelson-Morley ink drop experiment for the use of punctuation marks such as colons and semicolons that require multiple drops of ink.

(10)

2. Prove that the second dual of a finite dimensional real vector space is naturally isomorphic to the given vector space, except when the weapon chosen is a single shot pistol.

(10)

4.3.3 Half points

The point values of questions, parts, subparts, and subsubparts can include half points. To specify half points, you either type

```
\half
```

immediately following the integer part of the point value or just type `\half` as the entire point value. That is, the valid point values and their (default) printed appearances are:

Typed:	0	\half	1	1\half	2	2\half	$\cdots$
Printed:	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$\cdots$

If you prefer, you can cause the fraction $\frac{1}{2}$ to be printed as $\frac{1}{2}$. To do this, you give the command

```
\usehorizontalhalf
```

after which the printed appearance of point values will be

Typed:	0	\half	1	1\half	2	2\half	$\cdots$
Printed:	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$\cdots$

If you want to return to using the default appearance, you can do that by giving the command

```
\useslantedhalf
```

4.3.4 Surrounding the points: Parentheses, brackets, or a box

If you prefer having the points enclosed in brackets instead of in parentheses, give the command

```
\bracketedpoints
```

For example, if you give the command `\bracketedpoints`, then the questions typed above will produce

1. [20 points] Why is there air?

2. What if there were no air?

    (a) [10 points] Describe the effect on the balloon industry.

    (b) [10 points] Describe the effect on the aircraft industry.

If you prefer having the points enclosed in a box instead of in parentheses, give the command

<div align="center">

`\boxedpoints`

</div>

For example, if you give the command `\boxedpoints`, then the questions typed above will produce

1. $\boxed{\text{20 points}}$ Why is there air?

2. What if there were no air?

    (a) $\boxed{\text{10 points}}$ Describe the effect on the balloon industry.

    (b) $\boxed{\text{10 points}}$ Describe the effect on the aircraft industry.

If you give the commands `\boxedpoints` and `\pointsinmargin`, then the above questions will produce

$\boxed{20}$ 1. Why is there air?

2. What if there were no air?

$\boxed{10}$ (a) Describe the effect on the balloon industry.

$\boxed{10}$ (b) Describe the effect on the aircraft industry.

If you give the commands `\bracketedpoints` and `\pointsinrightmargin`, then the above questions will produce

1. Why is there air?   [20]

2. What if there were no air?

    (a) Describe the effect on the balloon industry.   [10]

    (b) Describe the effect on the aircraft industry.   [10]

Other combinations of these commands will produce similar effects.

If you want to switch back and forth between formats during the exam, you can do so by giving one of the commands

<div align="center">

`\boxedpoints`
`\bracketedpoints`
`\noboxedpoints`
`\nobracketedpoints`

</div>

whenever you want to switch. (The commands `\nobracketedpoints` and `\noboxedpoints` are equivalent; they both return to the default of putting parentheses around the points.)

If you want some text (e.g., " points", or "%") automatically inserted along with the point values when using either `\pointsinmargin` or `\pointsinrightmargin`, see the command `\marginpointname` in section **??**.

4.3.5   Using a substitute for the word "points"

With the default setup, the number of points is inserted before the text of the question followed by a single space and the word "point" if the number of points is either ½ or 1 and by the word "points" otherwise. That is, the default is `\nopointsinmargin` and `\noboxedpoints` (see sections **??** and **??**), and if you type

```
\begin{questions}
  \question[1]
  This is a short question.

  \question[5]
  This is a longer question, requiring more thought.
\end{questions}
```

then you'll get

1. (1 point) This is a short question.

2. (5 points) This is a longer question, requiring more thought.

The way this is achieved is:

- There is a command

    $$\text{\texttt{\textbackslash points}}$$

    whose default definition expands to the word 'point' if the number of points is either ½ or 1 and to 'points' otherwise. (This behavior can be modified by the command `\pointpoints`; see below.)

- There is a command

    $$\text{\texttt{\textbackslash pointname\{Text\}}}$$

    that causes 'Text' to be inserted following the number of points of a question, part, subpart, or subsubpart. The default setup is the result of the command

    $$\text{\texttt{\textbackslash pointname\{ \textbackslash points\}}}$$

    (Note the single space before the command `\points`.)

    There is also a command

    $$\text{\texttt{\textbackslash pointpoints\{SingularText\}\{PluralText\}}}$$

that changes the behavior of the `\points` command so that it expands to 'SingularText' if the number of points is ½ or 1 and to 'PluralText' otherwise. (The default is the result of the command `\pointpoints{point}{points}`.) Thus, if you give the command

$$\texttt{\textbackslash pointpoints\{Punkt\}\{Punkte\}}$$

then typing the questions above would result in

1. (1 Punkt) This is a short question.

2. (5 Punkte) This is a longer question, requiring more thought.

There is also a command

$$\texttt{\textbackslash marksnotpoints}$$

that is equivalent to the two commands

```
\pointpoints{mark}{marks}
\bonuspointpoints{mark (bonus)}{marks (bonus)}
```

(the command \bonuspointpoints is described in section **??**). That command would cause the above questions to be printed as

1. (1 mark) This is a short question.

2. (5 marks) This is a longer question, requiring more thought.

For another example, if you give the command

$$\texttt{\textbackslash pointname\{\textbackslash\%\}}$$

then the above questions would be printed as

1. (1%) This is a short question.

2. (5%) This is a longer question, requiring more thought.

Using \marginpointname

Similarly, the command \marginpointname can be used to affect the text set with the number of points when \pointsinmargin or \pointsinrightmargin is in effect. For example, if you give the commands

```
\pointsinmargin
\marginpointname{\%}
```

and then type

```
\question[25]
Where, oh where, has my little dog gone?
```

then you'll get

(25%)   1. Where, oh where, has my little dog gone?

unless, e.g., you've also given the command `\boxedpoints` (see section **??**), in which case you'll get

25%   1. Where, oh where, has my little dog gone?

If you give the commands

```
\marksnotpoints
\marginpointname{ \points}
```

then the above will print

(25 marks)   1. Where, oh where, has my little dog gone?

Using the default is equivalent to giving the command

```
\marginpointname{}
```

4.3.6   Using `\marginpointname` and enlarging the margins

The default margins are not very large, and so if you use `\marginpointname` (see section **??**) to place any words along with the point values in the margin, you may run out of room. The solution to this problem is to enlarge the margins by using the `\extrawidth` command with a negative argument to *decrease* the width of the text area, and thus *increase* the width of the margins. For example, the commands

```
\extrawidth{-1in}
\marginpointname{ \points}
```

will increase each of the left and right margins by one half inch, which will easily leave room for the word "points". (See section **??** for a discussion of the `\extrawidth` command.)

4.3.7   Completely customizing the points

If the customizations described in section **??** and section **??** (using `\bracketedpoints`, `\boxedpoints`, `\pointpoints`, `\pointname`, and `\marginpointname`) aren't sufficient, and you don't want to use the `\qformat` command to create a customized question number line (see section **??**), you can completely customize the way the points are printed by using the commands

```
\pointformat
\bonuspointformat
```

The `\pointformat` command controls the printing of "regular" points (i.e., non-bonus points) and the `\bonuspointformat` command controls the printing of bonus points (see section **??**).

Each of the commands `\pointformat` and `\bonuspointformat` takes one argument, and that argument is what actually appears on the page whether the points are being printed at the beginning of the question (the default), in the left margin (because of `\pointsinmargin`), in the right margin (because of `\pointsinrightmargin`), or dropped in the right margin at the end of the question (because of `\pointsdroppedatright`). The arguments to `\pointformat` and `\bonuspointformat` should contain either the command

$$\verb|\thepoints|$$

(which for non-bonus points prints the number of points followed by the argument to the last `\pointname` command and for bonus points prints the number of bonus points followed by the argument to the last `\bonuspointname` command; see section **??**) or the command

$$\verb|\themarginpoints|$$

(which for non-bonus points prints the number of points followed by the argument to the last `\marginpointname` command and for bonus points prints the number of bonus points followed by the argument to the last `\marginbonuspointname` command; see section **??**). If the argument doesn't contain either `\thepoints` or `\themarginpoints`, then the number of points will not appear.

For example, the command `\bracketedpoints` is equivalent to either

```
\pointformat{[\thepoints]}
\bonuspointformat{[\thepoints]}
```

if the points are being printed at the beginning of the question, or

```
\pointformat{[\themarginpoints]}
\bonuspointformat{[\themarginpoints]}
```

if the points are being printed in one of the margins.

For another example, the command `\boxedpoints` is equivalent to either

```
\pointformat{\fbox{\thepoints}}
\bonuspointformat{\fbox{\thepoints}}
```

if the points are being printed at the beginning of the question, or

```
\pointformat{\fbox{\themarginpoints}}
\bonuspointformat{\fbox{\themarginpoints}}
```

if the points are being printed in one of the margins.

For another example, the commands

```
\begin{questions}
  \pointsinmargin
  \marginpointname{\%}
  \pointformat{\slshape (\themarginpoints)}
  \question[3] What is the point?
\end{questions}
```

will produce

(3%) 1. What is the point?

For another example, the commands

```
\begin{questions}
  \pointsinrightmargin
  \marginpointname{\%}
  \pointformat{\fbox{\bfseries\boldmath\themarginpoints}}
  \question[3\half] What is the point?
\end{questions}
```

will produce

1. What is the point? $\boxed{\mathbf{3\frac{1}{2}\%}}$

(Note: The commands \bfseries and \boldmath are both needed here because the ½ printed when you use half points is printed in math mode while the rest of the points are printed in text mode.)

For another example, the commands

```
\begin{questions}
  \pointname{}
  \pointformat{\bfseries\boldmath(Points for this problem: \thepoints)}
  \question[3\half] What is the point?
\end{questions}
```

will produce

1. **(Points for this problem: 3½)** What is the point?

4.3.8   Questions that begin with a parts environment

If a question begins with a parts environment, then the question number and the number of the first part in the parts environment will be printed on the same line (see section **??**). Thus, if points are assigned to both the question and to the first part, both of those point values will be printed on the same line. (Note: This was not true in versions of the exam document class earlier than 2.3. In those versions, only the later of the two point values would actually be printed.) If \pointsinmargin or \pointsinrightmargin are in effect (see section **??**), then the two point values will be printed on top of each other, which is probably not what you want. The same problem arises if a part begins with a subparts environment or if a subpart begins with a subsubparts environment.

If you want to assign points to both a question and to each part of a parts environment, and if the first part will begin on the same line as the question, the solution is to either use the default location (i.e., \nopointsinmargin) or to put some of the points in the margin and others not. For example, if you type

```
\begin{questions}
  \pointsinmargin
  \noaddpoints
  \question[10]
```

```
\begin{parts}
  \nopointsinmargin
  \addpoints
  \part[5] Who put the ``bop'' in the ``bop, sh-bop, sh-bop''?
  \part[5] Who put the ``ram'' in the ``rama, rama ding-dong''?
\end{parts}
\end{questions}
```

then you'll get

(10%) 1. (a) (5 points) Who put the "bop" in the "bop, sh-bop, sh-bop"?

(b) (5 points) Who put the "ram" in the "rama, rama ding-dong"?

4.3.9 Adding up the points for a question

If you use the document class option `addpoints` (as in `\documentclass[addpoints]{exam}`) or give the command `\addpoints` (see section **??**), then you can use the command

<div align="center">

`\droptotalpoints`

</div>

to put into the right margin the total number of points for the current question (including the points for all parts, subparts, and subsubparts). (Section **??** describes a different way to print the total number of points for a question.) The command `\droptotalpoints` should be used only at the end of a paragraph or between paragraphs; if you use it within a paragraph, it causes the paragraph to end. `\droptotalpoints` prints the total points for the current question in the right margin, formatted by default as:

<div align="right">

Total for Question 2: 25

</div>

(Note: The number of points is followed by the argument to the most recently executed `\marginpointname` command (see section **??**), which by default is empty.)

If the current question is worth any bonus points (see section **??**), then those bonus points will not be counted by the `\droptotalpoints` command, but they will be counted by the

<div align="center">

`\droptotalbonuspoints`

</div>

command, which puts into the right margin the total number of bonus points for the current question, formatted by default as:

<div align="right">

Total for Question 2: 10 (bonus)

</div>

(Note: The number of bonus points is followed by the argument to the most recently executed `\marginbonuspointname` command (see section **??**), which by default is " (bonus)".)

You can change the format used by the `\droptotalpoints` command with the

<div align="center">

`\totalformat`

</div>

command. It takes one argument, and that argument becomes the command to print the total points, right justified a distance of `\rightpointsmargin` from the right edge of the paper. The argument can contain the command

\totalpoints to print the number of points, and
\thequestion to print the question number.

(\totalpoints expands to \pointsofquestion{\arabic{question}}; see section **??** for a discussion of the \pointsofquestion command.) For example, if you give the command

\totalformat{Question \thequestion: \totalpoints}

then the total number of points will be printed in the format

Question 2: 25

and if you give the command

\totalformat{\fbox{Total: \totalpoints}}

then the total number of points will be printed as

Total: 25

Thus, if you've given the commands

```
\addpoints
\bracketedpoints
\pointsdroppedatright
```

and you type

```
\question
\begin{parts}
\part[10]
In no more than one paragraph, explain why the earth is round.
\droppoints
\part[10]
What changes to the van Allen radiation belt are needed to
make the earth into a regular icosahedron?
\droppoints
\end{parts}
\droptotalpoints
```

then you'll get

1. (a) In no more than one paragraph, explain why the earth is round. [10%]

   (b) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron? [10%]

Total for Question 1: 20

If you've also given the command

\totalformat{Total for Question \thequestion: [\totalpoints]}

then you'll get

1. (a) In no more than one paragraph, explain why the earth is round. [10%]

   (b) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron? [10%]

$$\text{Total for Question 1: [20]}$$

To change the format used by the `\droptotalbonuspoints` command, you use the command

$$\text{\bonustotalformat}$$

which is analogous to the `\totalformat` command. The argument to `\bonustotalformat` can contain the command

`\totalbonuspoints`	to print the number of bonus points, and
`\thequestion`	to print the question number.

(`\totalbonuspoints` expands to `\bonuspointsofquestion{\arabic{question}}`; see section **??** for a discussion of the `\bonuspointsofquestion` command.)

4.3.10   Margin sizes when using `\pointsinmargin` and `\pointsinrightmargin`

- If you give the command `\pointsinmargin`, then the points are printed right justified in the left margin, with the right edge a distance of `\marginpointssep` from the left edge of the text area. The default value of `\marginpointssep` is the result of the command

$$\text{\setlength\{\marginpointssep\}\{5pt\}}$$

  and you can change it by giving a new `\setlength` command.

- If you give the command `\pointsinrightmargin`, then the points are printed right justified in the right margin, with the right edge a distance of `\rightpointsmargin` from the right edge of the paper. The default value of `\rightpointsmargin` is the result of the command

$$\text{\setlength\{\rightpointsmargin\}\{1cm\}}$$

  and you can change it by giving a new `\setlength` command.

You can change the width of the text area (and, thus, change the width of the margins) with the `\extrawidth` command (see section **??**).

4.4 Custom question number lines: The \qformat command

The default setup is for the question number to appear in the left margin and for the text of the question to begin on that line. It's possible to change this so that the text of the question starts on the line following the question number, and the format of the line containing the question number is determined by the user. This is done using the \qformat command. There is also a \noqformat command, which reverts to the default setup.

To use the \qformat command, you give the command

\qformat{Format specification}

where Format specification must contain some stretchability (e.g., at least one \hfill or \dotfill or \hrulefill or ...) and can contain the commands

- \thequestion, which expands to the question number,

- \thequestiontitle (see section **??**), which expands to

  - the title of the question, if this question was defined using a \titledquestion command (see section **??**) instead of a \question command, or

  - the number of the question, if this question was defined using a \question command,

- \thepoints, which expands to

  - the number of points followed by the argument to the last \pointname command, if there were points specified for the question, or

  - nothing, if no points were specified for the question

  (see section **??** for a discussion of the \pointname command), and

- \totalpoints, which expands to the total number of points specified for the question and all of its parts, subparts, and subsubparts (see section **??**). The command \totalpoints expands to \pointsofquestion{\arabic{question}} (see section **??**).

For example, if you give the commands

```
\qformat{Question \thequestion \dotfill \thepoints}
\begin{questions}
\question[10]
What did Billy Joe MacAllister throw off the Tallahatchie Bridge?
\end{questions}
```

then you'll get

Question 1...10 points
       What did Billy Joe MacAllister throw off the Tallahatchie Bridge?

If you instead use the command

```
\qformat{\textbf{Question \thequestion}\quad (\thepoints)\hfill}
```

then you'll get

Question 1   (10 points)
    What did Billy Joe MacAllister throw off the Tallahatchie Bridge?

If you instead use the command

```
\qformat{\hfill Question \thequestion\hfill (\thepoints)}
```

then you'll get

<div align="center">Question 1   (10 points)</div>

    What did Billy Joe MacAllister throw off the Tallahatchie Bridge?

If you use a `\qformat` (and, if there are any bonus questions, also a `\bonusqformat`; see section **??**), so that there are no labels on any of the questions, and you'd like to remove the indentation of the questions, you should give the command

```
\renewcommand{\questionshook}{%
  \setlength{\leftmargin}{0pt}%
  \setlength{\labelwidth}{-\labelsep}%
}
```

(see section **??**) before the `questions` environment.

4.4.1   Adding up the points for a question

You can combine `\qformat` with the `\totalpoints` command (see section **??**): If you assign points only to parts, subparts, and subsubparts of questions, but none to the questions themselves, and you give the command

```
\qformat{Question \thequestion\dotfill \emph{\totalpoints\ points}}
```

(you must have used the document class option `addpoints` or given the command `\addpoints` in order to use the `\totalpoints` command; see section **??**), then you can type

```
\begin{questions}
  \question
  \begin{parts}
    \part[10]
    In no more than one paragraph, explain why the earth is round.
    \part[10]
    What changes to the van Allen radiation belt are needed to make
    the earth into a regular icosahedron?
  \end{parts}
\end{questions}
```

and you'll get

Question 1 . . . . *20 points*

    (a) (10 points) In no more than one paragraph, explain why the earth is round.

    (b) (10 points) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron?

For another method of printing the total points for a question, see the `\droptotalpoints` command in section **??**.

4.5   Titled questions

The `\titledquestion` command (see section **??**) allows you to assign a *title* to a question, and to have the question title replace the question number in a grading table or point table indexed by question number (see sections **??** and **??**). If you use a `\qformat` (see section **??**) then you can include the question title in the question by using the `\thequestiontitle` command (see the example in section **??**).

4.5.1   \titledquestion

The command `\titledquestion` is a replacement for `\question`; it takes one required argument, the title, and one optional argument, the point value, as in

$$\texttt{\titledquestion\{Question \thequestion: Concepts\}}$$

which sets the question title to "Question 2: Concepts" (if this is the second question) and doesn't set any point values, or

$$\texttt{\titledquestion\{Design\}[10]}$$

which sets the question title to "Design" and sets the point value to "10". Note that the question title doesn't include the number of the question unless you put it there using the `\thequestion` command.

Using `\titledquestion` instead of `\question` doesn't change the appearance of the question (unless you use `\thequestiontitle` in the argument of a `\qformat` command; see section **??**). The only direct effect of using `\titledquestion` instead of `\question` is that if you print a grading table or point table indexed by question number (see section **??**), then the title of the question will replace the number of the question in the table. To have the title of the question appear in the question itself, see the example in section **??**.

If you create a grading table or point table indexed by question number and you create a question using the `\titledquestion` command, then the number of the question won't appear in the table unless you include `\thequestion` in the title of the question.

4.5.2 \thequestiontitle

The command \thequestiontitle expands to

- the title of the question (if the question was defined using a \titledquestion command) or

- the number of the question (if the question was defined using a \question command).

This is for use in the argument of a \qformat command (see section **??**), so that you can have the question title appear in the question itself, and not just in a grading table or point table.

The contents of \thequestiontitle don't appear anywhere in the question itself unless you do something to make them appear. For example, if you give the command

```
\qformat{Question \thequestion: \thequestiontitle\dotfill\thepoints}
```

and then type

```
\begin{questions}
  \titledquestion{History of Empirical Aerodynamics}[10]
  What did Billy Joe MacAllister throw off the Tallahatchie Bridge?
\end{questions}
```

then you'll get

Question 1: History of Empirical Aerodynamics...............................10 points
    What did Billy Joe MacAllister throw off the Tallahatchie Bridge?

If the command \thequestiontitle is never used, then the only effect of using the command \titledquestion instead of the command \question is that, in a grading table or point table indexed by question number, this question will be indexed by the title of the question rather than by the question number, and the title of the question will never appear except in the table.

4.6   Bonus points

It's possible to create questions, parts, subparts, or subsubparts that are worth *bonus points*, instead of regular points. To do this, you use the command

\bonusquestion	instead of	\question,
\bonustitledquestion	instead of	\titledquestion,
\bonuspart	instead of	\part,
\bonussubpart	instead of	\subpart, and
\bonussubsubpart	instead of	\subsubpart.

There is also a \bonusqformat command that affects the \bonusquestion command in the same way that the \qformat command affects the \question command (see section **??**), and a \nobonusqformat command that cancels the effect of \bonusqformat in the same way that \noqformat cancels the effect of \qformat. Note that the command \thepoints is defined so that it works equally well in \qformat and \bonusqformat commands (see section **??**).

If you don't assign any points to a \bonusquestion, \bonuspart, \bonussubpart, or \bonussubsubpart then, aside from the fact that \bonusqformat alters \bonusquestion while \qformat alters \question, then they're printed in the same way that they would be printed if you had used the corresponding non-bonus command. However, if you assign points, then

- the points are typeset differently (see below),

- the points are not counted by the \gradetableor \pointtable commands (see sections **??** and **??**) or their partial variants (see section **??**), though they *are* counted by the \bonusgradetable, \bonuspointtable, \combinedgradetable, and \combinedpointtable commands and their partial variants (see sections **??** and **??**),

- the points are not counted by the \droptotalpoints command (see section **??**), though they are counted by the \droptotalbonuspoints command (see below),

- the points are not counted by the \pointsofquestion (see section **??**) or \pointsonpage (see section **??**) commands, though they *are* counted by the \bonuspointsofquestion and \bonuspointsonpage (see section **??**) commands, and

- the points are not counted by the \numpoints command (see section **??**), though they *are* counted by the \numbonuspoints command (see section **??**).

The default setup is that if you type

```
\begin{questions}
  \question[10] Who discovered America?
  \bonusquestion[1] On what day of the week did he do it?
  \bonusquestion[2] What color shirt was he wearing?
\end{questions}
```

then you'll get

1. (10 points) Who discovered America?

2. (1 point (bonus)) On what day of the week did he do it?

3. (2 points (bonus)) What color shirt was he wearing?

There is also a command \bonuspointpoints that is analogous to \pointpoints (see section **??**); the default setup was created by the command

$$\texttt{\textbackslash bonuspointpoints\{point (bonus)\}\{points (bonus)\}}$$

and if you give the command

$$\texttt{\textbackslash bonuspointpoints\{bonus point\}\{bonus points\}}$$

then typing the above would produce

1. (10 points) Who discovered America?

2. (1 bonus point) On what day of the week did he do it?

3. (2 bonus points) What color shirt was he wearing?

There are also commands

| `\bonuspointname` and `\marginbonuspointname` | that are analogous to | `\pointname` and `\marginpointname` |

(see section **??**), and commands

| `\droptotalbonuspoints`, `\bonustotalformat`, and `\totalbonuspoints` | that are analogous to | `\droptotalpoints`, `\totalformat`, and `\totalpoints` |

(see section **??**).

4.7   Counting the questions and adding up the points

The exam document class automatically counts the numbers of questions, parts, and subparts, and makes these numbers available as the macros

```
\numquestions
\numparts
\numsubparts
\numsubsubparts
```

These numbers are also printed on the screen when you run LaTeX and they are placed into the `.log` file as well. If you have more than one `questions` environment (for example, if your exam has several parts, with the questions in each part numbered beginning with "1"), then `\numquestions` will hold the total number of questions on the exam. If you do have more than one `questions` environment, though, you won't be able to use the `\gradetable` or `\pointtable` commands (see section **??**).

   If you use the document class option `addpoints` or give the command `\addpoints` (see section **??**), then the class will add the total number of points and the total number of bonus points (see section **??**) that you've given to all of the questions, parts, subparts, and subsubparts of the exam, and make those totals available in the macros

```
\numpoints
\numbonuspoints
```

as well as displaying those totals on the screen when you run LaTeX and placing them into the `.log` file. You can then type

```
\begin{center}
  This exam has \numquestions\ questions, for a total of \numpoints\
  points and \numbonuspoints\ bonus points.
\end{center}
```

and you'll get

> This exam has 8 questions, for a total of 120 points and 10 bonus points.

Warning: If `addpoints` is in effect, your point values for questions, parts, subparts, and subsubparts must not contain anything other than digits and the command `\half` (see section **??**). For example, if you *don't* give the command `\addpoints`, then you can type

$$\text{\texttt{\textbackslash question[10\textbackslash\%]}}$$

with no problems, but this will cause errors if you've given the command `\addpoints`. The correct way to accomplish what you want is to give the command `\marginpointname{\%}` or `\pointname{\%}` and then type `\question[10]` (see section **??**).

If you want to temporarily turn off the adding of points (for example, if you list both the total points for each question and the points for each part, but you don't want to count the points twice), you can give the command

$$\text{\texttt{\textbackslash noaddpoints}}$$

to turn off the adding of points and the command `\addpoints` to turn it back on.

If `addpoints` is in effect, then you can create grading tables (see section **??**) and point tables (see section **??**) and use the commands `\pointsofquestion` (see section **??**) and `\pointsonpage` (see section **??**).

4.8 Referring to specific questions by number (cross references)

You can use the standard LaTeX commands `\label` and `\ref` to refer to questions (or parts, or subparts, or subsubparts) by number. For example, if you type

```
The first question is question number~\ref{ques:first}.
Question number~\ref{ques:second} has both a good part
(part~\ref{part:good}) and a bad part (part~\ref{part:bad}).

\begin{questions}
\question
\label{ques:first}
This is the first question.

\question
```

```
\label{ques:second}
\begin{parts}
\part
\label{part:good}
This is the good part.

\part
\label{part:bad}
This is the \emph{bad} part.
\end{parts}

\question
Is there a question?
\end{questions}
```

then you'll get:

The first question is question number **??**. Question number **??** has both a good part (part **??**) and a bad part (part **??**).

1. This is the first question.

2. (a) This is the good part.

   (b) This is the *bad* part.

3. Is there a question?

As with all other cross references in LATEX, you'll have to run your file through LATEX *twice* to be sure that all the cross references are correct.

4.9   Customizing the numbers

The default setup is that:

1. Question numbers are arabic, and are followed by a period.
   (a) Part numbers are lower case letters, and are enclosed in parentheses.
       i. Subpart numbers are lower case roman, and are followed by a period.
          α) Subsubpart numbers are greek, and are followed by a right parenthesis.
                A. Choices are upper case letters, and are followed by a period.

All of this can be changed.

To change the type of numbering, you would redefine the commands

```
\thequestion
\thepartno
\thesubpart
\thesubsubpart
\thechoice
```

(Note: The second one listed there is \thepartno, *not* \thepart. The command \thepart refers to the counter used in the article document class standard sectioning command \part.) The numbering commands available are

\arabic	Regular arabic integers
\alph	Lower case letters
\Alph	Upper case letters
\roman	Lower case roman numbers
\Roman	Upper case roman numbers
\greeknum	Greek letters

and any of these can be applied to the countersquestion, partno, subpart, subsubpart, and choice. (The \greeknum command is defined by the exam document class, but all of the others are standard LaTeX commands.)

For example, to have questions numbered using upper case roman numbers and parts numbered using upper case letters, you would give the commands

```
\renewcommand{\thequestion}{\Roman{question}}
\renewcommand{\thepartno}{\Alph{partno}}
```

The "decorations" around the numbers (i.e., the periods, or parentheses, or ...) are determined by the commands

```
\questionlabel
\partlabel
\subpartlabel
\subsubpartlabel
\choicelabel
```

the default definitions of which are:

```
\newcommand{\questionlabel}{\thequestion.}
\newcommand{\partlabel}{(\thepartno)}
\newcommand{\subpartlabel}{\thesubpart.}
\newcommand{\subsubpartlabel}{\thesubsubpart)}
\newcommand{\choicelabel}{\thechoice.}
```

You can change any of these by giving \renewcommand commands to redefine them. This can, of course, be used to change the "decorations" around the numbers, but there are other uses as well. For example, if you use the Fourier project's Utopia font by including the commands

```
\usepackage[T1]{fontenc}
\usepackage{fourier}
```

after your `\documentclass` command, then you'll see that the kerning makes "F." look so much like "E" that a student could confuse the two. You can turn off the kerning with the command `\renewcommand{\choicelabel}{\thechoice{}.}`.

4.10 Customizing the list parameters

The environments `questions`, `parts`, `subparts`, `subsubparts`, `choices`, and `checkboxes` are all implemented as LaTeX `list` environments. This section describes commands for advanced users who want to customize the list parameters (`\topsep`, `\partopsep`, `\itemsep`, `\parsep`, etc.) for the lists that those environments create.

The `exam` document class includes the expansion of

`\questionshook`	when creating a	`questions`	environment,
`\partshook`	when creating a	`parts`	environment,
`\subpartshook`	when creating a	`subparts`	environment,
`\subsubpartshook`	when creating a	`subsubparts`	environment,
`\choiceshook`	when creating a	`choices`	environment, and
`\checkboxeshook`	when creating a	`checkboxes`	environment.

The `exam` document class defines these as follows:

```
\newcommand{\questionshook}{}
\newcommand{\partshook}{}
\newcommand{\subpartshook}{}
\newcommand{\subsubpartshook}{}
\newcommand{\choiceshook}{}
\newcommand{\checkboxeshook}{}
```

Thus, the default is that these commands have no effect, but you can change any of them with a `\renewcommand` command. Thus, if you redefine, e.g., `\questionshook` to expand to commands that set values for some of the list parameters, then those values will be used in the `questions` environment.

For example, if you give the command

```
\renewcommand{\questionshook}{\setlength{\itemsep}{1in}}
```

then there will be an additional one inch of blank space inserted between questions (since the questions are the items in a `questions` environment). For another example, if you give the command

```
\renewcommand{\partshook}{\setlength{\topsep}{0.5in}}
```

then each parts environment will have an additional one half inch of space before and after the environment.

For another example, if you're using a `\qformat` (see section **??**) (and, if there are any bonus questions, also a `\bonusqformat`; see section **??**), so that there are no labels on any of the questions, and you'd like to remove the indentation of the questions, give the command

```
\renewcommand{\questionshook}{%
  \setlength{\leftmargin}{0pt}%
  \setlength{\labelwidth}{-\labelsep}%
}
```

5   Multiple choice and fill in the blank questions

There are four environments for listing the possible answers to a multiple choice question: two of them label the choices, and the other two print checkboxes in front of the choices for the student to place checks next to the chosen answers.

- The first two environments use upper case letters (i.e., "A", "B", "C", ...) to label the choices. (To change the appearance of the labels, see section **??**.)

  - The `choices` environment creates a list environment with the choices as the items in the list (see section **??**).
  - The `oneparchoices` environment lists all of the choices in a single paragraph which is a continuation of the paragraph preceding the environment unless you leave a blank line before beginning the environment (see section **??**).

  If you don't want the students to just circle the correct choices, you can use the `\answerline` command to print a line on which the answer should be written (see section **??**). The `\anwerline` command allows you to include as an optional argument the answer to the question, and the answer will be printed on the line when solutions are bing printed (see section **??**).

- The last two environments print checkboxes in front of the choices for the students to use to place checks next to the chosen answers.

  - The `checkboxes` environment creates a list environment with the choices as the items in the list (see section **??**).
  - The `oneparcheckboxes` environment lists all of the choices in a single paragraph which is a continuation of the paragraph preceding the environment unless you leave a blank line before beginning the environment (see section **??**).

All of those environments allow you to designate one or more choices as correct choices and to have the correct choices printed with emphasis when solutions are being printed (see section **??**).

5.1   The `choices` environment

For example, if you type

```
\begin{questions}
\question
One of these things is not like the others; one of these things is not
the same.  Which one is different?
\begin{choices}
\choice John
\choice Paul

\choice

George

\choice Ringo

\choice Socrates

\end{choices}

\end{questions}
```

Then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?

> A. John
>
> B. Paul
>
> C. George
>
> D. Ringo
>
> E. Socrates

As that example illustrates, you can leave blank lines between the `\choice` command and the text of the choice, or between the various choices, and those blank lines will be ignored.

5.2   The `oneparchoices` environment

If you use a `oneparchoices` environment instead of the `choices` environment in the example of section **??**, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?   A. John   B. Paul   C. George   D. Ringo   E. Socrates

If you insert a blank line before the `\begin{oneparchoices}`, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?

   A. John   B. Paul   C. George   D. Ringo   E. Socrates

If you insert a blank line before the `\begin{oneparchoices}` and `\answerline` after the `\end{oneparchoices}` (see section **??** for a description of the `\answerline` command), then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?

   A. John   B. Paul   C. George   D. Ringo   E. Socrates

1. _____

5.3   The `checkboxes` environment

If you use a `checkboxes` environment instead of the `choices` environment in the example of section **??**, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?
   - ◯ John
   - ◯ Paul
   - ◯ George
   - ◯ Ringo
   - ◯ Socrates

The appearance of the checkbox can be customized (see section **??**).

5.4   The `oneparcheckboxes` environment

If you use a `oneparcheckboxes` environment instead of the `choices` environment in the example of section **??**, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different? ◯ John   ◯ Paul   ◯ George   ◯ Ringo   ◯ Socrates

   If you insert a blank line before the `\begin{oneparcheckboxes}`, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?

   ◯ John   ◯ Paul   ◯ George   ◯ Ringo   ◯ Socrates

The appearance of the checkbox can be customized (see section **??**).

5.5 Solutions to multiple choice questions

The `exam` document class defines several environments for solutions (see section **??**), the contents of which will be printed only if you use the document class option `answers` (as in `\documentclass[answers]{exam}`) or give the command `\printanswers` (see section **??**). Each of the environments for multiple choice questions (see sections **??**–**??**) allows you to designate one or more of the choices as *correct choices*, and to have the correct choices printed with emphasis when solutions are being printed.

The command to define a correct choice is `\CorrectChoice`, which is used in place of the command `\choice`. (To avoid confusion, `\correctchoice` is defined to be a synonym for `\CorrectChoice`.) When solutions are not being printed, `\CorrectChoice` is equivalent to `\choice`. When solutions are being printed, though, any choices that were created with `\CorrectChoice` (rather than with `\choice`) will be printed in bold. (This can be changed; see section **??**.) In addition, in the `checkboxes` and `oneparcheckboxes` environments, each correct choice will have its checkbox replaced by a check.

For example, if `\printanswers` is in effect and you type

```
\begin{questions}
  \question One of these things is not like the others; one of these
  things is not the same.  Which one is different?
  \begin{oneparchoices}
    \choice John
    \choice Paul
    \choice George
    \choice Ringo
    \CorrectChoice Socrates
  \end{oneparchoices}
\end{questions}
```

then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?   A. John   B. Paul   C. George   D. Ringo   **E. Socrates**

If you use a `oneparcheckboxes` environment instead of the `oneparchoices` environment in that example, then you'll get

1. One of these things is not like the others; one of these things is not the same. Which one is different?   ◯ John   ◯ Paul   ◯ George   ◯ Ringo   √ **Socrates**

5.6 Fill in the blank questions

There is a `\fillin` command that prints underlined empty space for creating "fill in the blank" questions. The `\fillin` command can take two optional arguments:

- the first optional argument is the answer to the question, which will be printed above the line when answers are being printed, and

- the second optional argument is the length of line to be printed, if you want some length other than the default.

If answers are being printed and you supply the answer as the first (and possibly only) optional argument, then the answer is printed subject to the declarations in the argument of the most recent `\CorrectChoiceEmphasis` command. It is centered on the line unless it is too long, in which case it extends to the right of the line. The default length of the line and the distance down from the baseline of the text to the empty line can both be customized (see section **??**).

For example, if you type

```
\begin{questions}
  \question \fillin is the color of my true love's hair.
\end{questions}
```

then you'll get

1. _____is the color of my true love's hair.

If, instead, you type

```
\begin{questions}
  \question \fillin[Black] is the color of my true love's hair.
\end{questions}
```

then if answers are not being printed you'll get

1. _____ is the color of my true love's hair.

and if answers are being printed you'll get

1. _____**Black**_____ is the color of my true love's hair.

For another example, if answers are being printed and you type

```
\begin{questions}
  \question The magic word is \fillin[prestidigitator].
\end{questions}
```

then you'll get

1. The magic word is **prestidigitator**.

which shows what happens when the answer is too long for the fillin line. If, however, you type

```
\begin{questions}
  \question The magic word is \fillin[prestidigitator][2in].
\end{questions}
```

then you'll get

1. The magic word is _____**prestidigitator**_____.

`\fillin` eats (and ignores) space characters appearing before the first optional argument. It also eats (and ignores) space characters appearing after the first optional argument and before the second optional argument. However, if exactly one optional argument appears, and if there are one or more space characters following that one optional argument, then those spaces are replaced by a single space character, but not eaten.

5.6.1 True/False questions

The `\fillin` command can also be used to create True/False questions. If you give the command

```
\newcommand{\tf}[1][{}]{%
  \fillin[#1][0.25in]%
}
```

then you can type

```
\begin{questions}
  \question \tf[T] The world is all that is the case.
  \question \tf[F] My favorite color is blue.
\end{questions}
```

and if answers are not being printed you'll get

1. ___ The world is all that is the case.

2. ___ My favorite color is blue.

but if answers are being printed then you'll get

1. _**T**_ The world is all that is the case.

2. _**F**_ My favorite color is blue.

5.6.2 Customizing the `\fillin` command

You can customize the `\fillin` command by changing

- the default length of the underlined space,

- the distance below the text baseline that the line is printed, and

- the emphasis applied to the answer (when answers are being printed).

The default length of the underlined space is called `\fillinlinelength`, and its value was set by the command

$$\setlength\fillinlinelength\{1in\}$$

You can change this by giving a new `\setlength` command.

The line is printed a distance of `\answerclearance` below the baseline, and its value was set by the command

$$\setlength\answerclearance\{0.2ex\}$$

You can change this by giving a new `\setlength` command. Note: `\answerclearance` is also used by the `\answerline` command (see section **??**).

When answers are being printed and you include the optional argument containing the answer, then the answer is printed subject to the declarations in the argument of the most recent `\CorrectChoiceEmphasis` command. The default situation was created by the command

$$\CorrectChoiceEmphasis\{\bfseries\}$$

and you can change this by giving a new `\CorrectChoiceEmphasis` command (see section **??**).

5.7 Customizing the multiple choice environments

When solutions are being printed, the correct choices in any of the environments `choices`, `oneparchoices`, `checkboxes`, and `oneparcheckboxes` will be printed subject to the declarations in the argument of the most recent

$$\CorrectChoiceEmphasis$$

command. The default situation is created by the command

$$\CorrectChoiceEmphasis\{\bfseries\}$$

and so when solutions are being printed the correct choices are printed in boldface by default. You can change this, for example, by giving the command

$$\CorrectChoiceEmphasis\{\itshape\}$$

which would cause correct choices to be printed in italics when solutions are being printed.

For another example, if you give the command `\usepackage{color}` in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}`), and then give the command

$$\CorrectChoiceEmphasis\{\color\{red\}\}$$

then when solutions are being printed the correct choices will be printed in red (assuming your printer can produce that color).

For another example, if you give the command `\usepackage{color}` in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}` command) and then give the command

$$\text{\textbackslash CorrectChoiceEmphasis\{\textbackslash color\{red\}\textbackslash bfseries\}}$$

then the correct choices will be printed in boldface red (again assuming that your printer can produce that color).

To avoid confusion, `\correctchoiceemphasis` is defined to be a synonym for `\CorrectChoiceEmphasis`.

The `checkboxes` and `oneparcheckboxes` environments also allow customization of the characters used for checkboxes and checks:

- The checkbox that is printed in the `checkboxes` and `oneparcheckboxes` environments is the argument of the most recent `\checkboxchar` command. The default is created by the command

$$\text{\textbackslash checkboxchar\{\$\textbackslash bigcirc\$\}}$$

  For example, if you give the command `\usepackage{amssymb}` in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}`), then the command

$$\text{\textbackslash checkboxchar\{\$\textbackslash Box\$\}}$$

  will cause squares to be printed instead of circles.

- The check that is printed for correct choices in the `checkboxes` and `oneparcheckboxes` environments when solutions are being printed is the argument of the most recent `\checkedchar` command. The default is created by the command

$$\text{\textbackslash checkedchar\{\$\textbackslash surd\$\}}$$

For example, if you've given the command `\usepackage{amssymb}` in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}`), then the commands

$$\text{\textbackslash checkboxchar\{\$\textbackslash Box\$\}}$$
$$\text{\textbackslash checkedchar\{\$\textbackslash blacksquare\$\}}$$

will cause the example in section **??** to appear as

1. One of these things is not like the others; one of these things is not the same. Which one is different? □ John   □ Paul   □ George   □ Ringo   ■ **Socrates**

6 Escaping the indentation: \uplevel and \fullwidth

There are two commands provided for printing text with a left margin smaller than the one currently in effect: \uplevel and \fullwidth. Each of these commands takes one argument and typesets the argument with an altered left margin.

The \fullwidth command prints its argument using the full width of the printed region, temporarily canceling the indentation created by the questions environment (and the parts, subparts, and subsubparts environments, if you're inside any of those). The \uplevel command prints its argument using the indentation in effect before you entered the current innermost environment.

There are also two environments, EnvUplevel and EnvFullwidth. The EnvUplevel environment is similar to the \uplevel command and the EnvFullwidth environment is similar to the \fullwidth command. The environments have the advantage that you can have verbatim material inside of the environment, while there cannot be any verbatim material in the argument of \uplevel or \fullwidth.

The main uses for these commands are including instructions for a group of questions (see section ??) and naming the parts of a long exam (see section ??), but you can use them however you like.

6.1 Including instructions for a group of questions

If you are inside of a parts environment and you want to give directions for the next few parts, then those directions should be indented to the level of the question of which they are parts, i.e., up one level. If you type

```
\begin{questions}
  \question
  Why did you come to Casablanca?

  \question
  \begin{parts}
    \part
    Why, Oh why, Oh why, Oh; why did I ever leave Ohio?

    \uplevel{The following two parts should be answered in classical
      Greek:}
    \part
    Why do birds sing?

    \part
    Why do fools fall in love?

  \end{parts}
\end{questions}
```

then you'll get

1. Why did you come to Casablanca?

2. (a) Why, Oh why, Oh why, Oh; why did I ever leave Ohio?

    The following two parts should be answered in classical Greek:

    (b) Why do birds sing?

    (c) Why do fools fall in love?

You can accomplish exactly the same thing by replacing

```
\uplevel{The following two parts should be answered in classical
  Greek:}
```

by

```
\begin{uplevel}
  The following two parts should be answered in classical Greek:
\end{uplevel}
```

   If you want to give instructions for a group of questions, then the indenting for those instructions should be to the outer left margin, i.e., up one level. For example, if you type

```
\begin{questions}
  \question
  Approximate $\displaystyle \int_0^1 \sin x^2 \, dx$ within $.001$ of
  its true value.

  \uplevel{Questions \ref{exact-start} through~\ref{exact-end} should
    be evaluated completely, not just approximated.}

  \question
  \label{exact-start}
  $\displaystyle \int_0^1 \frac{x^2 \, dx}{\sqrt{1-x^2}}$

  \question
  $\displaystyle \int_0^1 \frac{1}{1+x^2}\, dx$

  \question
  \label{exact-end}
  $\displaystyle \int_0^{\frac{\pi}{2}} \sin^3 x \cos x \, dx$
\end{questions}
```

you'll get

1. Approximate $\displaystyle\int_0^1 \sin x^2\,dx$ within .001 of its true value.

Questions **??** through **??** should be evaluated completely, not just approximated.

2. $\displaystyle\int_0^1 \frac{x^2\,dx}{\sqrt{1-x^2}}$

3. $\displaystyle\int_0^1 \frac{1}{1+x^2}\,dx$

4. $\displaystyle\int_0^{\frac{\pi}{2}} \sin^3 x \cos x\,dx$

You can accomplish exactly the same thing by replacing

```
\uplevel{Questions \ref{exact-start} through~\ref{exact-end} should
  be evaluated completely, not just approximated.}
```

by

```
\begin{EnvUplevel}
  Questions \ref{exact-start} through~\ref{exact-end} should be
  evaluated completely, not just approximated.
\end{EnvUplevel}
```

If you want to give instructions that use the full width of the page (rather than just going up one level of indentation), then use the \fullwidth command. For example, if you type

```
\begin{questions}
  \question
  This is the first question.

  \question
  \begin{parts}
    \part
    This is the first part.

    \part
    This is the second part.
    \begin{subparts}
      \subpart
      This is a subpart.

      \fullwidth{When you finish this exam, you should go back and
        reexamine your work, both on this exam and in your life up
        until the day of this exam, for any errors that you may have
```

```
        made.}

      \subpart
      This is another subpart.
    \end{subparts}
  \end{parts}
\end{questions}
```

then you'll get

1. This is the first question.

2. (a) This is the first part.

   (b) This is the second part.
       i. This is a subpart.

When you finish this exam, you should go back and reexamine your work, both on this exam and in your life up until the day of this exam, for any errors that you may have made.
       ii. This is another subpart.

You can accomplish exactly the same thing by replacing

```
\fullwidth{When you finish this exam, you should go back and
  reexamine your work, both on this exam and in your life up
  until the day of this exam, for any errors that you may have
  made.}
```

by

```
\begin{EnvFullwidth}
  When you finish this exam, you should go back and
  reexamine your work, both on this exam and in your life up
  until the day of this exam, for any errors that you may have
  made.
\end{EnvFullwidth}
```

6.2 Naming the parts of a long exam

There are two ways of naming the parts of a long exam. The first way uses the \fullwidth and \uplevel commands (see section **??**), and the other way uses the standard \part and \section commands (see section **??**).

6.2.1 Using \uplevel and \fullwidth

To place a section name in the exam, just use a `\fullwidth` command (see section **??**) and include whatever font changing commands that you want to use. For example, if you type

```
\begin{questions}
  \question
  Is there, is there balm in Gilead?

  \fullwidth{\Large \textbf{Essay questions}}

  \question
  Explain how the cooling of matter in the centuries following the big
  bang has influenced the British parliamentary system of government.

  \fullwidth{\Large \textbf{Laboratory questions}}

  \question
  In the cabinet below your laboratory bench you will find a single
  edged razor blade, several C-clamps, and a bottle of whiskey.
  Remove your appendix.  Do not suture until your work has been
  inspected.
\end{questions}
```

then you'll get

1. Is there, is there balm in Gilead?

Essay questions

2. Explain how the cooling of matter in the centuries following the big bang has influenced the British parliamentary system of government.

Laboratory questions

3. In the cabinet below your laboratory bench you will find a single edged razor blade, several C-clamps, and a bottle of whiskey. Remove your appendix. Do not suture until your work has been inspected.

You can accomplish exactly the same thing by replacing

```
  \fullwidth{\Large \textbf{Essay questions}}
```

by

```
  \begin{EnvFullwidth}
    \Large \textbf{Essay questions}
  \end{EnvFullwidth}
```

and replacing

```
\fullwidth{\Large \textbf{Laboratory questions}}
```

by

```
\begin{EnvFullwidth}
  \Large \textbf{Laboratory questions}
\end{EnvFullwidth}
```

6.2.2 Using the standard sectioning commands

The exam document class is built upon the standard article document class, and so the sectioning commands used with the article document class can be used here as well. In particular, you can give the commands `\part`, `\part \part*`, `\section`, and `\section*`. The definitions made in `exam.cls` ensure that if a `\part` command appears *outside of a parts environment* it will be interpreted as a sectioning command, while if it appears *inside of a parts environment* it will be interpreted as beginning a new part of a question.

You can give these commands in the middle of a questions environment so as not to interrupt the numbering of the questions, or you can end a questions environment, give a sectioning command, and then start a new questions environment (which would reset the question counter to start again with number 1). If you have more than one questions environment, though, then you will be unable to use any of the commands that create grading tables or point tables (see section **??**) or the commands that change the headers and footers depending on whether or not a question spans multiple pages (see section **??**).

If you give any of these commands while inside of a questions environment, then the section titles will be indented to the same extent that questions are indented unless they are given as the argument of a `\fullwidth` or `\uplevel` command. These commands have the advantage, however, that the unstarred versions provide automatic numbering of the parts or sections.

7 Leaving space for the answers

There are five different kinds of space that you can create:

- Blank space (see section **??**),

- an empty box (see section **??**),

- space filled with lines (see section **??**),

- space filled with dotted lines (see section **??**), and

- space filled with a grid (see section **??**).

You can also create answer lines for short answer questions (see section **??**). In section **??** we describe five environments for typing solutions to questions:

- `solution`,

- `solutionorbox`,

- `solutionorlines`,

- `solutionordottedlines`, and

- `solutionorgrid`.

Each of those environments can take an optional argument specifying an amount of space to be created when solutions are not being printed; see section **??**.

7.1   Leaving blank space

To leave blank space on the page for the answer to a question, you should use the `\vspace*` command. For example, the command `\vspace*{1in}` inserts one inch of vertical space after the line in which it appears. (If it appears in between paragraphs, then it inserts the space right there.) You can also use the `\vspace` command, the difference being that space inserted by `\vspace` will be deleted if it occurs at the top of a new page, whereas space inserted by `\vspace*` will never be deleted.

If you want to leave all the remaining space on the page blank, you should give the commands

```
\vspace*{\stretch{1}}
\newpage
```

If you want to equally distribute the blank space among several questions on the page, then just put `\vspace*{\stretch{1}}` after each of the questions and use `\newpage` to end the page. You can also distribute the available space in some other ratio. For example, to give one of the questions on the page twice as much space as any of the others, put `\vspace*{\stretch{2}}` after that question and `\vspace*{\stretch{1}}` after each of the others.

You can also leave blank space when solutions are not being printed by using an optional argument with a `solution` environment; see section **??**.

7.2   Printing an empty box

You can print an empty box with the command

```
\makeemptybox{length}
```

which prints an empty box of height `length` whose width equals that of the current line. That is, the left edge is at the current left margin (which depends on whether we're in a question, part, subpart, or subsubpart) and the right edge is at the right margin.

For example, if you type

```
\begin{questions}
  \question
  In no more than one paragraph, explain why the earth is round.

  \makeemptybox{1in}

  \question
  \begin{parts}
    \part
    What changes to the van Allen radiation belt are needed to make
    the earth into a regular icosahedron?

    \makeemptybox{1in}

    \part
    Where should the field generator be constructed if you want one of
    the vertices to be located at the Royal Observatory at Greenwich?

    \makeemptybox{1in}

  \end{parts}
\end{questions}
```
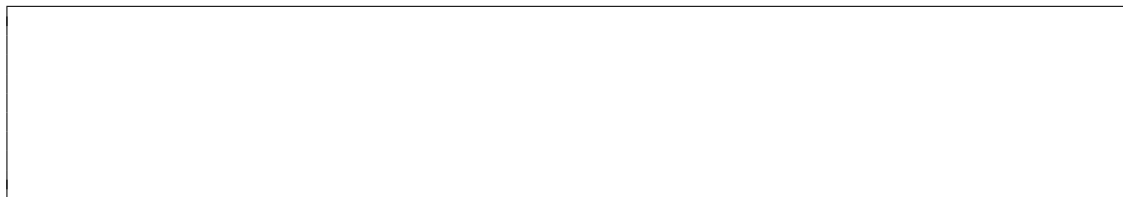
then you'll get

1. In no more than one paragraph, explain why the earth is round.

   ```



   ```

2. (a) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron?

   ```



   ```

   (b) Where should the field generator be constructed if you want one of the vertices to be located at the Royal Observatory at Greenwich?

If you want to fill the remaining space on the page with an empty box, you should give the commands

```
\makeemptybox{\stretch{1}}
\newpage
```

If you want to equally distribute the space for the answers among several questions on the page, then just put `\makeemptybox{\stretch{1}}` after each of those questions and use `\newpage` to end the page. You can also distribute the available space in some other ratio. For example, to give one of the questions on the page twice as much space as any of the others, put `\makeemptybox{\stretch{2}}` after that question, `\makeemptybox{\stretch{1}}` after each of the others, and use `\newpage` to end the page.

You can also insert an empty box when solutions are not being printed by including an optional argument with the `solutionoremptybox` environment; see section **??**.

7.3 Printing lined space

You can fill space with lines with the command

```
\fillwithlines{length}
```

which fills vertical space of height `length` with horizontal lines that run the length of the current line. That is, they extend from the current left margin (which depends on whether we're in a question, part, subpart, or subsubpart) to the right margin.

For example, if you type

```
\begin{questions}
  \question
  In no more than one paragraph, explain why the earth is round.

  \fillwithlines{1in}

  \question
  \begin{parts}
    \part
    What changes to the van Allen radiation belt are needed to make
    the earth into a regular icosahedron?
```

```
    \fillwithlines{1in}

    \part
    Where should the field generator be constructed if you want one of
    the vertices to be located at the Royal Observatory at Greenwich?

    \fillwithlines{1in}

  \end{parts}
\end{questions}
```

then you'll get

1. In no more than one paragraph, explain why the earth is round.

   _____

   _____

   _____

   _____

2. (a) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron?

   _____

   _____

   _____

   _____

   (b) Where should the field generator be constructed if you want one of the vertices to be located at the Royal Observatory at Greenwich?

   _____

   _____

   _____

   _____

   The distance between the lines is `\linefillheight`, the default value of which is set with the command

$$\setlength\linefillheight{.25in}$$

That value can be changed by giving a new `\setlength` command. The thickness of the lines is `\linefillthickness`, the default value of which is set with the command

$$\setlength\linefillthickness{0.1pt}$$

and that value can also be changed by giving a new `\setlength` command.

If you want to fill the remaining space on the page with lines, you should give the commands

<div align="center">

`\fillwithlines{\stretch{1}}`
`\newpage`

</div>

If you want to equally distribute the space for the answers among several questions on the page, then just put `\fillwithlines{\stretch{1}}` after each of those questions and use `\newpage` to end the page. You can also distribute the available space in some other ratio. For example, to give one of the questions on the page twice as much space as any of the others, put `\fillwithlines{\stretch{2}}` after that question, `\fillwithlines{\stretch{1}}` after each of the others, and use `\newpage` to end the page.

You can also insert lined space when solutions are not being printed by including an optional argument with the `solutionorlines` environment; see section **??**.

7.4 Printing dotted lined space

You can fill space with dotted lines with the command

<div align="center">

`\fillwithdottedlines{length}`

</div>

which fills vertical space of height `length` with dotted horizontal lines that run the length of the current line. That is, they extend from the current left margin (which depends on whether we're in a question, part, subpart, or subsubpart) to the right margin. The command `\fillwithdottedlines` is almost identical to the `\fillwithlines` command (see section **??**), except that the lines created are dotted and the distance between the lines is `\dottedlinefillheight`. The default value of `\dottedlinefillheight` is set by the command

<div align="center">

`\setlength\dottedlinefillheight{.25in}`

</div>

and that value can be changed by giving a new `\setlength` command.

For example, if you type

```
\begin{questions}
  \question
  In no more than one paragraph, explain why the earth is round.

  \fillwithdottedlines{1in}

  \question
  \begin{parts}
    \part
    What changes to the van Allen radiation belt are needed to make
    the earth into a regular icosahedron?
```

```
    \fillwithdottedlines{1in}

    \part
    Where should the field generator be constructed if you want one of
    the vertices to be located at the Royal Observatory at Greenwich?

    \fillwithdottedlines{1in}

  \end{parts}
\end{questions}
```

then you'll get

1. In no more than one paragraph, explain why the earth is round.

   . . . .

   . . . .

   . . . .

   . . . .

2. (a) What changes to the van Allen radiation belt are needed to make the earth into a regular icosahedron?

   . . . .

   . . . .

   . . . .

   . . . .

   (b) Where should the field generator be constructed if you want one of the vertices to be located at the Royal Observatory at Greenwich?

   . . . .

   . . . .

   . . . .

   . . . .

If you want to fill the remaining space on the page with dotted lines, you should give the commands

```
\fillwithdottedlines{\stretch{1}}
\newpage
```

If you want to equally distribute the space for the answers among several questions on the page, then just put `\fillwithdottedlines{\stretch{1}}` after each question on the page and use `\newpage` to end the page. You can also distribute the available space in some other ratio. For example, to give one of the questions on the page twice as much

space as any of the others, put `\fillwithdottedlines{\stretch{2}}` after that question, `\fillwithdottedlines{\stretch{1}}` after each of the others, and use `\newpage` to end the page.

You can also insert dotted lined space when solutions are not being printed by including an optional argument with the `solutionordottedlines` environment; see section **??**.

7.5 Printing space filled with a grid

You can fill space with a grid with the command

$$\text{\texttt{\textbackslash fillwithgrid\{length\}}}$$

which fills vertical space of height `length` with a grid that runs the length of the current line. That is, it extends from the current left margin (which depends on whether we're in a question, part, subpart, or subsubpart) to the right margin. The default grid size and grid line thickness were set by the commands

$$\text{\texttt{\textbackslash setlength\{\textbackslash gridsize\}\{5mm\}}}$$
$$\text{\texttt{\textbackslash setlength\{\textbackslash gridlinewidth\}\{0.1pt\}}}$$

You can change either or both of those by giving new `\setlength` commands. The period of the grid is `\gridsize` (both horizontally and vertically). That is, the horizontal distance from the left edge of one vertical line to the left edge of the next vertical line is `\gridsize`, as is the vertical distance from the top edge of one horizontal line to the top edge of the next horizontal line. Thus, each square has outer side length equal to `\gridsize+\gridlinewidth`.

By default, the created grids are in black. However, if you give the commands

$$\text{\texttt{\textbackslash usepackage\{color\}}}$$
$$\text{\texttt{\textbackslash colorgrids}}$$

then the grids will be in color, by default a light gray. That default color was defined by the command

$$\text{\texttt{\textbackslash definecolor\{GridColor\}\{gray\}\{0.8\}}}$$

You can change the color by giving a new `\definecolor` command to redefine the color `GridColor`.

For example, if you type

```
\begin{questions}
  \question
  In no more than one paragraph, explain why the earth is round.

  \smallskip\fillwithgrid{1in}

  \question
  \begin{parts}
```

```
\part
What changes to the van Allen radiation belt are needed to make
the earth into a regular icosahedron?

\smallskip\fillwithgrid{1in}

\part
Where should the field generator be constructed if you want one of
the vertices to be located at the Royal Observatory at Greenwich?

\smallskip\fillwithgrid{1in}

  \end{parts}
\end{questions}
```

then you'll get

1. In no more than one paragraph, explain why the earth is round.

2. (a) What changes to the van Allen radiation belt are needed to make the earth into a
   regular icosahedron?

   (b) Where should the field generator be constructed if you want one of the vertices to
   be located at the Royal Observatory at Greenwich?

   If you want to fill the remaining space on the page with a grid, you should give the
commands

```
\fillwithgrid{\stretch{1}}
\newpage
```

If you want to equally distribute the space for the answers among several questions on the page, then just put `\fillwithgrid{\stretch{1}}` after each question on the page and use `\newpage` to end the page. You can also distribute the available space in some other ratio. For example, to give one of the questions on the page twice as much space as any of the others, put `\fillwithgrid{\stretch{2}}` after that question, `\fillwithgrid{\stretch{1}}` after each of the others, and use `\newpage` to end the page.

You can also insert a grid only when solutions are not being printed by including an optional argument with the `solutionorgrid` environment; see section **??**.

7.5.1 Covering every page with a grid

If you'd like *every* page to be completely covered by a grid, with the exam printed right on top of that grid, you can do that by using a `\fillwithgrid` command in the footer. For this, make sure you're using either `\pagestyle{headandfoot}` (the default) or `\pagestyle{foot}` (see section **??**), and put the following into your preamble (i.e., after the `\documentclass` command and before the `\begin{document}` command):

```
\usepackage{color}
\colorgrids
\newlength{\scratchlength}
\newcommand{\gridfromfoot}{%
  \setlength{\scratchlength}{\textheight}%
  \addtolength{\scratchlength}{\baselineskip}%
  \leavevmode\rlap{\vbox to 0pt{%
      \vss
      \fillwithgrid{\scratchlength}%
      \vspace*{\footskip}%
    }% vbox
  }% rlap
}% gridfromfoot

\footer{\gridfromfoot Math 115}
       {}
       {Page \thepage\ of \numpages}
```

7.5.2 Printing graph paper

You can also use the `\fillwithgrid` command to print graph paper:

```
\documentclass{exam}
\pagestyle{empty}
\begin{document}

\fillwithgrid{\stretch{1}}
```

```
\newpage

\fillwithgrid{\stretch{1}}

\end{document}
```

7.6   Short answer questions

The exam class can print answer lines for short answer questions. The command

```
\answerline
```

leaves blank vertical space of length `\answerskip` and then inserts a horizontal line of length `\answerlinelength` at the right margin, preceded by the number of the current question, part, subpart, or subsubpart. The default values of `\answerskip` and `\answerlinelength` are set by the commands

```
\setlength\answerskip{2ex}
\setlength\answerlinelength{1in}
```

and these can be changed by giving new `\setlength` commands. If you use the command `\answerline` outside of a `questions` environment, then the number before the line will be omitted.

For example, if you type

```
\begin{questions}
  \question
  Who's buried in Grant's tomb?
  \answerline

  \question
  What was the color of George Washington's white horse?
  \answerline

  \question
  Which is heavier: A pound of feathers, or a pound of lead?
  \answerline
\end{questions}
```

then you'll get

 1. Who's buried in Grant's tomb?

<div align="right">1. _____</div>

2. What was the color of George Washington's white horse?

2. ——————

3. Which is heavier: A pound of feathers, or a pound of lead?

3. ——————

and if you type

```
\begin{questions}
  \question
  Answer the following questions on the lines at the right:
  \begin{parts}
    \part
    Who's buried in Grant's tomb? \answerline

    \part
    \begin{subparts}
      \subpart
      What light through yonder window breaks? \answerline

      \subpart
      To be, or not to be; that is the question? \answerline
    \end{subparts}

    \part
    What was the color of George Washington's white horse? \answerline
  \end{parts}
\end{questions}
```

then you'll get

1. Answer the following questions on the lines at the right:

   (a) Who's buried in Grant's tomb?

(a) ——————

   (b) i. What light through yonder window breaks?

i. ——————

       ii. To be, or not to be; that is the question?

ii. ——————

   (c) What was the color of George Washington's white horse?

(c) ——————

7.7 Printing the answers to short answer questions

The \answerline command can take an optional argument so that you can have the answer to the question printed on the answer line when answers are being printed (see section **??**). When answers are not being printed, the optional argument is ignored.

When answers are being printed, the optional argument is printed subject to the declarations in the argument of the last \CorrectChoiceEmphasis command (which by default is \bfseries; see section **??**), and it is printed a distance of \answerclearance above the line. The default value of \answerclearance is set with the command

\setlength\answerclearance{0.2ex}

and it can be changed with a \setlength command. The optional argument is centered on the answer line unless it is longer than the line, in which case it extends to the right of the line.

For example, if you type

```
\begin{questions}
  \question Who was the fifth Beatle? \answerline[Murray the K]
  \question What is the answer to the ultimate question of life, the
  universe, and everything? \answerline[42]
\end{questions}
```

and if \noprintanswers (the default) is in effect, you'll get

1. Who was the fifth Beatle?

    1. _____

2. What is the answer to the ultimate question of life, the universe, and everything?

    2. _____

while if \printanswers is in effect, you'll get

1. Who was the fifth Beatle?

    1. **Murray the K**

2. What is the answer to the ultimate question of life, the universe, and everything?

    2. _____**42**_____

8 Solutions

8.1 Solution environments

There are six environments for typing solutions to the problems. These environments all allow you to either print the solutions or omit them with a single command. Whether or not solutions are printed is controlled by the two commands

<div align="center">

`\printanswers`
`\noprintanswers`

</div>

Using these commands to turn printing of solutions on and off, you can print the solutions for the entire exam or for only certain parts of it. The default is that solutions are *not* printed. There is also an `answers` option to the `exam` document class, used as in

<div align="center">

`\documentclass[answers]{exam}`

</div>

that is equivalent to giving the command `\printanswers` at the beginning of the document (see section **??**).

The six environments for solutions are divided into two types.

- The `solutionorbox` environment (see section **??**) always prints a box, of whatever size you choose, and if solutions are being printed it prints the solution inside of the box.

- Each of the remaining five (see section **??**),

<div align="center">

the	`solution`	environment,
the	`solutionorbox`	environment,
the	`solutionorlines`	environment,
the	`solutionordottedlines`	environment, and
the	`solutionorgrid`	environment,

</div>

  by default prints either the solution or nothing at all. However, they all can take one optional argument, which is an amount of space to be left when solutions are not being printed. If you use these environments without any optional arguments, then they are identical: They print either the solution or nothing at all. They differ only in the type of space they leave when you do include the optional argument and solutions are not being printed.

  The differences between these five environments are that if the optional argument is used and solutions are not being printed, then

  - the `solution` enviroment inserts that amount of blank space, as if you had given a `\vspace*` command (see section **??**),

  - the `solutionorbox` environment inserts an empty box of that height, as if you had given a `\makeemptybox` command (see section **??**),

– the `solutionorlines` environment inserts that amount of space with ruled lines, as if you had given a `\fillwithlines` command (see section **??**),

– the `solutionordottedlines` environment inserts that amount of space with dotted lines, as if you had given a `\fillwithdottedlines` command (see section **??**), and

– the `solutionorgrid` environment inserts that amount of space filled with a grid, as if you had given a `\fillwithgrid` command (see section **??**).

You can use a parts, subparts, or subsubparts environment inside any of the solution environments without having their points (if any) counted as actual points on the exam. If there are points assigned to any of these commands inside any of the solution environments, those points are not added to the points of the question or the points on the page, and do not affect any gradetables or pointtables.

8.2 The appearance of the solution

The solutions printed by the

> `solution`,
> `solutionorbox`,
> `solutionorlines`,
> `solutionordottedlines`, and
> `solutionorgrid`

environments can be printed either

- in a box (i.e., an `\fbox`) (see section **??**; this is the default),

- on a shaded background (see section **??**), or

- with no framing or shading (see section **??**).

In all of these cases, solutions can be broken across pages, and the part on each page will be boxed or shaded as appropriate.

8.2.1 Printing the solution in a box

By default, the solution is printed inside of a box (i.e., an `\fbox`), and if the solution is broken across pages, then each piece is enclosed in a box. There is also a `\shadedsolutions` command to instead have the solution printed in a `\colorbox` (i.e., printed on a shaded background); for this, you must load the `color` package and your printer must be capable of printing color, or at least grayscale (see section **??**).

For example, if you type

```
\begin{questions}
  \question Did you mutter something?

  \begin{solution}
    Once upon a midnight dreary, while I pondered, weak and weary,
    Over many a quaint and curious volume of forgotten lore--- While I
    nodded, nearly napping, suddenly there came a tapping, As of some
    one gently rapping, rapping at my chamber door.  ''\,'Tis some
    visitor,'' I muttered, ''tapping at my chamber door--- Only this
    and nothing more.''
  \end{solution}
\end{questions}
```

and you've given the command `\printanswers` or used the document class option `answers` (see section **??**), then you'll get

1. Did you mutter something?

> **Solution:** Once upon a midnight dreary, while I pondered, weak and weary, Over many a quaint and curious volume of forgotten lore— While I nodded, nearly napping, suddenly there came a tapping, As of some one gently rapping, rapping at my chamber door. "'Tis some visitor," I muttered, "tapping at my chamber door— Only this and nothing more."

The result would be exactly the same if that `solution` environment were replaced by a `solutionorbox`, `solutionorlines`, `solutionordottedlines`, or `solutionorgrid` environment.

By default, the solution is printed in a box whose width equals that of the text of the current question (or part, or subpart, or subsubpart). That is, the indentation at the left of the solution equals the current level of indentation. You can change this by enclosing the `solution`, `solutionorbox`, `solutionorlines`, `solutionordottedlines`, or `solutionorgrid` environment in the argument of a `\fullwidth` or `\uplevel` command, or inside of a `EnvFullwidth` or `EnvUplevel`environment (see section **??**). For example, if you type

```
\begin{questions}
  \question Did you mutter something?

  \begin{EnvFullwidth}
    \begin{TheSolution}
      Once upon a midnight dreary, while I pondered, weak and weary,
      Over many a quaint and curious volume of forgotten lore--- While
      I nodded, nearly napping, suddenly there came a tapping, As of
```

```
      some one gently rapping, rapping at my chamber door.  ``\,'Tis
      some visitor,'' I muttered, ``tapping at my chamber door--- Only
      this and nothing more.''
    \end{TheSolution}
  \end{EnvFullwidth}
\end{questions}
```

and you've given the command `\printanswers` or used the document class option `answers`, then you'll get

1. Did you mutter something?

> **Solution:** Once upon a midnight dreary, while I pondered, weak and weary, Over many a quaint and curious volume of forgotten lore— While I nodded, nearly napping, suddenly there came a tapping, As of some one gently rapping, rapping at my chamber door. "'Tis some visitor," I muttered, "tapping at my chamber door— Only this and nothing more."

With all of these environments, if solutions are not being printed then the contents of the environment are ignored. If, however, you include the optional argument (see section **??**), then the requested amount of space (blank, lined, or dotted lined) will be inserted when the solution isn't printed.

8.2.2   Printing the solution on a shaded background

If you load the `color` package with the command

$$\usepackage\{color\}$$

in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}` command), then you can give the command

$$\shadedsolutions$$

This will cause solutions to be printed on a shaded background, which by default is a light gray. (Most laser printers can at least print grayscale when printing with the correct driver.) If you want to change the color of the shading, you can do so by redefining the color `SolutionColor`. For example, if you give the command

$$\definecolor\{SolutionColor\}\{rgb\}\{0.8,0.9,1\}$$

then the solutions will be printed on a light blue background (assuming that your printer is capable of producing that color).

If you want to switch back to printing solutions inside of an `\fbox`, you can do so by giving the command

$$\framedsolutions$$

which returns you to the default situation.

8.2.3 Printing the solution with no framing or shading

If you give the command

```
\unframedsolutions
```

then solutions will be printed as normal text, with no framing or shading. If you use this option, you'll almost certainly want to use the command \SolutionEmphasis (see section **??**) to distinguish the solution from the surrounding text.

If you want to switch back to printing solutions inside of an \fbox, you can do so by giving the command

```
\framedsolutions
```

which returns you to the default situation.

8.3 Customizing the solution

The solutions printed by any of the solution environments (see section **??**) can be customized:

- the title (by default, "**Solution:**") can be changed (see section **??**),

- emphasis can be applied to the solution to distinguish it from the surrounding text (see section **??**), and

- advanced users can entirely change the appearance of the solutions by defining a LaTeX environment (see section **??**).

8.3.1 The title

The word "**Solution:**" that you see at the beginning of the solutions printed by the solution, solutionorbox, solutionorlines, and solutionordottedlines environments can be changed by redefining the command \solutiontitle. The default value was created by the command

```
\newcommand{\solutiontitle}{\noindent\textbf{Solution:}\enspace}
```

If, for example, you give the command

```
\renewcommand{\solutiontitle}{\noindent\textbf{Solution:}\par\noindent}
```

then the solution environment above would print

1. Did you mutter something?

> **Solution:**
>
> Once upon a midnight dreary, while I pondered, weak and weary, Over many a quaint and curious volume of forgotten lore— While I nodded, nearly napping, suddenly there came a tapping, As of some one gently rapping, rapping at my chamber door. "'Tis some visitor," I muttered, "tapping at my chamber door— Only this and nothing more."

8.3.2 Solution emphasis

You can change the appearance of the text of the solution with the `\SolutionEmphasis` command. The contents of the solution are enclosed in a group, and that group is begun with the argument of the most recent `\SolutionEmphasis` command. The default was created by the command

$$\text{\SolutionEmphasis\{\}}$$

That is, the default is not to add any emphasis at all. If, for example, you give the command

$$\text{\SolutionEmphasis\{\itshape\small\}}$$

then the solutions will be set in italics, in small type. For another example, if you've given the command `\usepackage{color}` in the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}`) and you give the command

$$\text{\SolutionEmphasis\{\color\{red\}\}}$$

then the solutions will be printed in red (assuming your printer is capable of producing that color).

Note: If you've given the command `\unframedsolutions` (see section **??**), so that solutions are printed as normal text with no framing or shading, then you'll almost certainly want to use the `\SolutionEmphasis` command to create some visible difference between the solutions and the surrounding text.

8.3.3 Advanced customizations

The appearance of all of these solution environments can actually be totally customized, if you're up to defining a LaTeX environment. The appearance of the solution typed into any of these environments is defined by an environment called `TheSolution`, and you can change the definition of `TheSolution` with a `\renewenvironment` command. That is, the `solution` environment decides whether the command `\printanswers` has been given and, if so, it feeds the contents of the `solution` environment into a `TheSolution` environment. (The behavior of a `solutionorbox`, `solutionorlines` or `solutionordottedlines` environment is similar.) If you use `\renewenvironment` to change the definition of the `TheSolution` environment, you'll be changing the way the solution is printed. For the default definition of the `TheSolution` environment, see the file `exam.cls`.

8.4   Leaving space for the answers when solutions aren't printed

Each of the `solution`, `solutionorbox`, `solutionorlines`, `solutionordottedlines`, and `solutionorgrid` environments takes an optional argument:

- In a `solution` environment this is an amount of blank space to be left (just as if you had used a `\vspace*` command; see section **??**) when solutions are not being printed,

- in a `solutionorbox` environment this is the height of an empty box to be drawn (just as if you had used a `\makeemptybox` command; see section **??**) when solutions are not being printed,

- in a `solutionorlines` environment this is an amount of lined space to be left (just as if you had used a `\fillwithlines` command; see section **??**) when solutions are not being printed,

- in a `solutionordottedlines` environment this is an amount of dotted lined space to be left (just as if you had used a `\fillwithdottedlines` command; see section **??**) when solutions are not being printed.

- in a `solutionorgrid` environment this is an amount of space to be filled with a grid (just as if you had used a `\fillwithgrid` command; see section **??**) when solutions are not being printed.

For example, if you type

```
\begin{solution}[2in]
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solution}
```

then there will be 2 inches of blank space inserted (as if you had given the command `\vspace*{2in}`; see section **??**) when solutions are not being printed, if you type

```
\begin{solutionorbox}[2in]
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solutionorbox}
```

then there will be an empty box 2 inches tall inserted (as if you had given the command `\makeemptybox{2in}`; see section **??**) when solutions are not being printed, if you type

```
\begin{solutionorlines}[2in]
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solutionorlines}
```

then there will be 2 inches of lined space inserted (as if you had given the command `\fillwithlines{2in}`; see section **??**) when solutions are not being printed, if you type

```
\begin{solutionordottedlines}[2in]
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solutionordottedlines}
```

then there will be 2 inches of dotted lined space inserted (as if you had given the command `\fillwithdottedlines{2in}`; see section **??**) when solutions are not being printed. and if you type

```
\begin{solutionorgrid}[2in]
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solutionordottedlines}
```

then there will be 2 inches of grid inserted (as if you had given the command `\fillwithgrid{2in}`; see section **??**) when solutions are not being printed.

8.4.1   Cancelling the space from the optional arguments

If you've typed any of the environments `solution`, `solutionorbox`, `solutionorlines`, `solutionordottedlines`, or `solutionorgrid` (see section **??**), and you've

- included an optional argument to leave space for answers when solutions are not being printed, but

- you would now like to print the exam *without* printing the solutions and *without* leaving space for the answers,

then you can cancel the space that would be created by the optional arguments by using the `cancelspace` document class option. That is, if you use the `\documentclass` command

$$\text{\texttt{\textbackslash documentclass[cancelspace]\{exam\}}}$$

then optional arguments to any of the four solution environments will be ignored. There are also commands `\cancelspace` and `\nocancelspace`; using the document class option `cancelspace` is equivalent to giving the command `\cancelspace` at the beginning of the file. The command `\nocancelspace` reverts to the default situation (in which the optional arguments are not ignored).

The document class option `cancelspace` has no effect at all if solutions are being printed.

Note: The document class option `cancelspace` and the command `\cancelspace` only affect the optional arguments of of the five solution environments; they do *not* affect any `\vspace` commands that you put into the file.

8.5   The solutionbox environment

The solutionbox environment is different from the other solution environments (`solution`, `solutionorbox`, `solutionorlines`, `solutionordottedlines`, and `solutionorgrid`), in that

1. The box is always printed, whether answers are being printed or not.

2. The argument giving the size of the box is a required argument, not an optional argument, and so it should be enclosed in braces, not in brackets. It can be either a length or `\stretch{number}`. Note: *It is the user's responsibility to be sure that the box is large enough to hold the solution!* If the solution takes up too much vertical space, then it will spill out of the bottom of the box, overwriting whatever follows the box.

3. The `solutionbox` environment makes no use of the `TheSolution` environment; the `solutionbox` environment is completely freestanding.

If answers are not being printed then only the box is printed, with nothing in it. If answers are being printed, then the solution is printed inside of the box.

For example, if you type

```
\begin{solutionbox}{2in}
  Once upon a midnight dreary, while I pondered, weak and weary, Over
  many a quaint and curious volume of forgotten lore--- While I
  nodded, nearly napping, suddenly there came a tapping, As of some
  one gently rapping, rapping at my chamber door.  ``\,'Tis some
  visitor,'' I muttered, ``tapping at my chamber door--- Only this and
  nothing more.''
\end{solutionbox}
```

(note that the amount of space is required, and is typed as "{2in}", rather than "[2in]") and solutions are not being printed, then you'll get
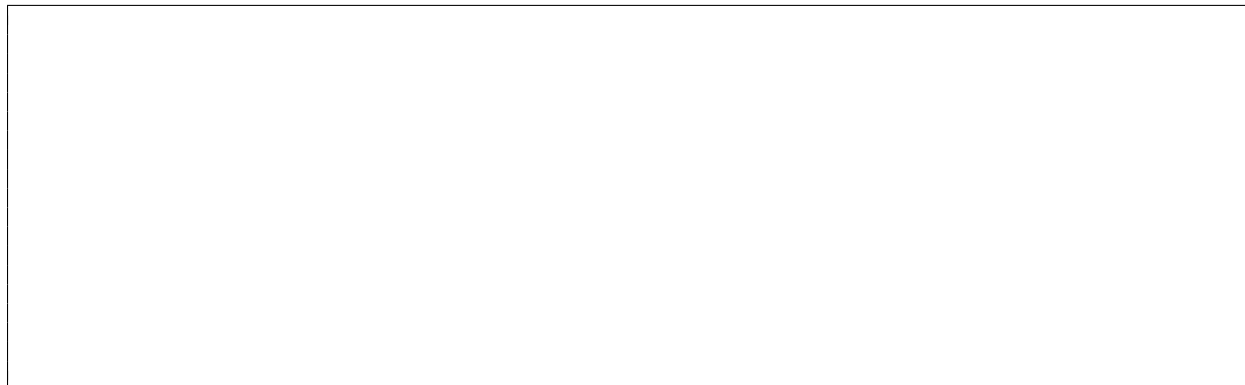
    If solutions *are* being printed, then the exact same box would be printed, but it would have the solution printed inside of it.

8.6   Changes depending on whether or not solutions are being printed

The command `\ifprintanswers` is provided in case you want to vary what appears on the exam in ways other than those provided by the solution environments (see section **??**), the `\CorrectChoice` command in multiple choice environments (see section **??**), and the optional argument to the `\answerline` command (see section **??**). You use this command by typing

```
\ifprintanswers
  Stuff to appear only when answers are being printed.
\else
  Stuff to appear only when answers are not being printed.
\fi
```

The `\else` clause is optional; you can also type

```
\ifprintanswers
  Stuff to appear only when answers are being printed.
\fi
```

If you want something printed only when answers are not being printed, you can type

```
\ifprintanswers
\else
  Stuff to appear only when answers are not being printed.
\fi
```

Since the `exam` document class automatically loads the `ifthen` package, you can accomplish the same things using the `\ifthenelse` command:

```
\ifthenelse{\boolean{printanswers}}
  {Stuff to appear only when answers are being printed.}
  {Stuff to appear only when answers are not being printed.}
```

If you use `\ifthenelse`, then `both` cases must be present, even if you leave one of them empty. Thus, e.g., if you want to print something only when answers are not being printed, you'd type

```
\ifthenelse{\boolean{printanswers}}
  {}
  {Stuff to appear only when answers are not being printed.}
```

8.6.1 Printing only selected solutions

The `\ifprintanswers` command can be used to print only certain of the solutions in an exam. To do that, you'd put the lines

```
\newif\ifprintselected
\printselectedtrue
%\printselectedfalse

\newenvironment{select}
{\ifprintselected
   \printanswers
 \fi
}
{}
```

into your preamble (i.e., after the `\documentclass` command and before the `\begin{document}` command). That defines a `select` environment, in which you can wrap any of the solution environments, as in

```
\begin{select}
  \begin{solutionorlines}[1in]
    Only when the number is two.
  \end{solutionorlines}
\end{select}
```

As long as you leave the command `\printselectedtrue` uncommented, then everything wrapped in a `select` environment will be printed. If you comment out `\printselectedtrue` and uncomment `\printselectedfalse`, then the `select` environment will have no effect.

9 Grading tables and point tables

The `exam` document class can print either

- a grading table, indexed either by question number or by page number, which lists the points possible and leaves space for you to fill in (by hand) the points earned (see section **??**), or

- a point table, indexed either by question number or by page number, which lists the points possible but does not leave space for you to fill in the points earned (see section **??**).

It's also possible to print either a grading table or point table to cover only part of the exam (see section **??**).

If the exam has any bonus points (see section **??**), then the bonus points will be ignored by the tables described in sections **??**, **??**, and **??**, but it's possible to print bonus grading tables and bonus point tables that list the bonus points and ignore the non-bonus points (see section **??**) or combined grading tables and combined point tables that list both regular points and bonus points (see section **??**).

9.1 Grading tables indexed by question number or by page number

The `exam` document class can print a grading table, indexed either by question number or by page number. That is, you can print

- a table listing the question numbers (or question titles for questions created using the `\titledquestion` command instead of the `\question` command; see section **??**) and the total points possible for each question (including all of its parts, subparts, and subsubparts) and leaving space for you to fill in (by hand) the points earned on each question, or

- a table listing each page that has at least one question, part, subpart, or subsubpart with points assigned to it, the total number of points possible on that page, and leaving space for you to fill in (by hand) the points earned on that page.

In order to use this feature you must either include the optional argument `addpoints` in your `\documentclass` command (as in `\documentclass[addpoints]{exam}`) or give the command `\addpoints` (see section **??**), and there must be only one `questions` environment in the entire exam. In addition, you must run LaTeX twice after making any changes to the file in order to make sure that the point values are correct on a grading table indexed by question number and at least three times for a grading table indexed by page number. (Since the table appears on the third run of LaTeX, and the space it occupies can change the page on which each question falls, it may take a fourth run of LaTeX for the table to have the points per page correct.)

The command to create a grading table is

$$\text{\textbackslash gradetable}$$

and it takes two optional arguments:

1. The first optional argument can be either [v] or [h], to choose between a vertically oriented table and a horizontally oriented table, and

2. the second optional argument can be either [questions] or [pages], to choose between a table indexed by question number and a table indexed by page number.

That is,

- \gradetable[v][questions] prints a vertically oriented table indexed by question number,

- \gradetable[h][questions] prints a horizontally oriented table indexed by question number,

- \gradetable[v][pages] prints a vertically oriented table indexed by page number, and

- \gradetable[h][pages] prints a horizontally oriented table indexed by page number.

If you leave out the optional arguments (i.e., if you give the command as "\gradetable") you'll get a vertically oriented table indexed by question number.

For example, if the exam has 8 questions, each worth a total of 15 points, and you type

```
\begin{center}
  \gradetable[v][questions]
\end{center}
```

then you'll get

Question	Points	Score
1	15	
2	15	
3	15	
4	15	
5	15	
6	15	
7	15	
8	15	
Total:	120	

and if you type

```
\begin{center}
  \gradetable[h][questions]
\end{center}
```

then you'll get

Question:	1	2	3	4	5	6	7	8	Total
Points:	15	15	15	15	15	15	15	15	120
Score:									

The number of points listed for a question is the sum of the point values for that question and all of its parts, subparts, and subsubparts.

If those 8 questions are distributed two to a page on each of pages 2 through 5 and if you type

```
\begin{center}
  \gradetable[v][pages]
\end{center}
```

then you'll get

Page	Points	Score
2	30	
3	30	
4	30	
5	30	
Total:	120	

and if you type

```
\begin{center}
  \gradetable[h][pages]
\end{center}
```

then you'll get

Page:	2	3	4	5	Total
Points:	30	30	30	30	120
Score:					

Warning: If you have a large number of questions on the exam, then these tables can easily become too large to fit on the page. If this becomes a problem, then you can either

- create grading ranges (see section **??**) and print several partial grading tables, making each one small enough to fit on the page, or

- use the `\pointsofquestion` command (see section **??**) or the `\pointsonpage` command (see section **??**) to create a custom `tabular` environment that has more rows (or columns) than the tables produced by the `gradingtable` command.

9.2   Point tables indexed by question number or by page number

Point tables are similar to grading tables (see section **??**), except that there is no place in the table to fill in the points earned.

The command to create a point table is

$$\text{\texttt{\textbackslash pointtable}}$$

and it takes two optional arguments:

1. The first optional argument can be either `[v]` or `[h]`, to choose between a vertically oriented table and a horizontally oriented table, and

2. the second optional argument can be either `[questions]` or `[pages]`, to choose between a table indexed by question number and a table indexed by page number.

That is,

- `\pointtable[v][questions]` prints a vertically oriented table indexed by question number,

- `\pointtable[h][questions]` prints a horizontally oriented table indexed by question number,

- `\pointtable[v][pages]` prints a vertically oriented table indexed by page number, and

- `\pointtable[h][pages]` prints a horizontally oriented table indexed by page number.

If you leave out the optional arguments (i.e., if you give the command as "`\pointtable`") you'll get a vertically oriented table indexed by question number.

For example, if the exam has 8 questions, each worth a total of 15 points, and you type

```
\begin{center}
  \pointtable[v][questions]
\end{center}
```

then you'll get

Question	Points
1	15
2	15
3	15
4	15
5	15
6	15
7	15
8	15
Total:	120

and if you type

```
\begin{center}
  \pointtable[h][questions]
\end{center}
```

then you'll get

Question:	1	2	3	4	5	6	7	8	Total
Points:	15	15	15	15	15	15	15	15	120

The number of points listed for a question is the sum of the point values for that question and all of its parts, subparts, and subsubparts.

If those 8 questions are distributed two to a page on each of pages 2 through 5 and if you type

```
\begin{center}
  \pointtable[v][pages]
\end{center}
```

then you'll get

Page	Points
2	30
3	30
4	30
5	30
Total:	120

and if you type

```
\begin{center}
  \pointtable[h][pages]
\end{center}
```

then you'll get

Page:	2	3	4	5	Total
Points:	30	30	30	30	120

Warning: If you have a large number of questions on the exam, then these tables can easily become too large to fit on the page. If this becomes a problem, then you can either

- create grading ranges (see section **??**) and print several partial point tables, making each one small enough to fit on the page, or

- use the `\pointsofquestion` command (see section **??**) or the `\pointsonpage` command (see section **??**) to create a custom `tabular` environment that has more rows (or columns) than the tables produced by the `pointtable` command.

9.3   Table entries as clickable links

If you put the command

```
\usepackage{hyperref}
```

into the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}` command) and then produce a pdf file (either using dvipdf or directly by using pdflatex), then

- in a grading table or point table indexed by question number the question numbers in the table will be clickable links that take you to the corresponding question, and

- in a grading table or point table indexed by page number the page numbers in the table will be clickable links that take you to the corresponding page.

If you create questions using the `\titledquestion` command instead of the `\question` command (see section **??**), then a grading table or point table indexed by question number will show the *titles* of those questions instead of the numbers of those questions, and those question titles will be clickable links that take you to the corresponding question.

9.4 Grading ranges, partial grading tables, and partial point tables

It is possible to define one or more "grading ranges", and then to count the points in a range and create grading tables and point tables that cover only that range.

In more detail: You can define a grading range by choosing a name with which to label the range, e.g., "myrange", and then putting the command

`\begingradingrange{myrange}` at the start of the range and the command

`\endgradingrange{myrange}` at the end of the range.

You can then use the commands

- `\pointsinrange{myrange}`, which will expand to the number of points in the range,

- `\firstqinrange{myrange}`, which will expand to the number of the first question in the range,

- `\lastqinrange{myrange}`, which will expand to the number of the last question in the range, and

- `\numqinrange{myrange}`, which will expand to the number of questions in the range.

You can define as many grading ranges as you like, wherever you like. That is, grading ranges do *not* need to be nested; you can begin the range `otherrange` somewhere in the middle of the range `myrange` and then end the range `otherrange` after the end of `myrange`.

You can create a grading table or point table that covers only the questions in a range by using the `\partialgradetable` or `\partialpointtable` command. These are similar to the `\gradetable` and `\pointtable` commands, except that they each have one required argument (the name of the grading range) before the two optional arguments (the first of which must be either `[v]` or `[h]` and the second of which must be either `[questions]` or `[pages]`). For example, the command

`\partialgradetable{myrange}[v][questions]`

would create a vertically grading oriented table indexed by the questions in the range, and the command

`\partialgradetable{myrange}[v][pages]`

would create a vertically oriented grading table indexed by all pages with points starting with the page containing the command `\begingradingrange{myrange}` and ending with the page containing the command `\endgradingrange{myrange}`

If the exam has any bonus points (see section **??**), then the bonus points will be ignored by the `\pointsinrange`, `\partialgradetable`, and `\partialpointtable` commands, but they will be counted by the `\bonuspointsinrange` command (see section **??**) and tabulated by the `\partialbonusgradetable`, `\partialbonuspointtable`, `\partialcombinedgradetable`, and `\partialcombinedponttable` commands (see section **??** and section **??**).

9.5 \pointsofquestion

If you use the document class option `addpoints` (as in `\documentclass[addpoints]{exam}`) or give the command `\addpoints` (see section **??**), then you can use the

<div align="center">

`\pointsofquestion`

</div>

command. This command takes one argument, which must be the number of a question on the exam, and it prints the total number of points for that question. That is:

- `\pointsofquestion{1}` prints the sum of the point values for question 1 and all of its parts, subparts, and subsubparts.

- `\pointsofquestion{2}` prints the sum of the point values for question 2 and all of its parts, subparts, and subsubparts.

- Etc.

The `\pointsofquestion` command is used by the `\gradetable` and `\pointtable` commands (see section **??**), and it can be used to create a table using LaTeX's `tabular` environment when the tables produced using the `\gradetable` and `\pointtable` commands either don't fit on the page or are unsuitable for some other reason. It can also be used in a `\qformat` command to list the total number of points of all parts, subparts, and subsubparts of a question on the line with the question number (see section **??**).

The `\pointsofquestion` command ignores any bonus points that you may have created (see section **??**). The `\bonuspointsofquestion` command, however, counts the bonus points (see section **??**).

9.6 \pointsonpage

If you use the document class option `addpoints` (as in `\documentclass[addpoints]{exam}`) or give the command `\addpoints` (see section **??**), then you can use the `\pointsonpage` command. This command takes one argument, which must be the number of a page of the exam, and it prints the total number of points for all the questions, parts, subparts, and subsubparts on that page. That is:

- `\pointsonpage{1}` prints the sum of the point values for all questions, etc., on page 1,

- `\pointsonpage{2}` prints the sum of the point values for all questions, etc., on page 2,

- Etc.

This command can be used to create a table using LaTeX's `tabular` environment when the tables produced using the `\gradetable` and `\pointtable` commands either don't fit on the page or are unsuitable for some other reason. It can also be used in headers and footers to print on each page the total number of points available on that page; for example, the command

```
\runningfooter{}
             {}
             {Points earned: \makebox[1in]{\hrulefill}
              out of a possible \pointsonpage{\thepage} points}
```

(see section **??**) will produce the footer

Points earned: _____ out of a possible 20 points

on all pages after the first. (For another example, see section **??**.)

Caution: The command `\pointsonpage{\thepage}` will work reliably only in headers and footers, since the command `\thepage` will work reliably only in headers and footers.

The `\pointsonpage` command ignores any bonus points that you may have created (see section **??**). The `\bonuspointsonpage` command, however, counts the bonus points (see section **??**).

9.7   Bonus grading tables and bonus point tables

If your exam contains any bonus points (see section **??**), then those bonus points will be ignored by the grading table and point table commands described in sections **??**, **??**, and **??** and by the `\pointsofquestion` (see section **??**) and `\pointsonpage` (see section **??**) commands. There are, however, analogous commands that count only the bonus points and ignore the non-bonus points. (There are also commands that create tables listing both non-bonus and bonus points; see section **??**.) These commands, and the non-bonus commands to which they correspond, are as follows:

Bonus points	Non-bonus points
`\bonusgradetable`	`\gradetable`
`\bonuspointtable`	`\pointtable`
`\bonuspointsinrange`	`\pointsinrange`
`\partialbonusgradetable`	`\partialgradetable`
`\partialbonuspointtable`	`\partialpointtable`
`\bonuspointsofquestion`	`\pointsofquestion`
`\bonuspointsonpage`	`\pointsonpage`

All of the the commands in the first column count bonus points and ignore non-bonus points, while all of the commands in the second column count non-bonus points and ignore bonus points. The `\partialbonusgradetable` and `\partialbonuspointtable` commands use the same `\begingradingrange` and `\endgradingrange` commands that are used by the corresponding non-bonus versions (see section **??**). Just as is described in section **??** for their non-bonus counterparts, if you put the command

```
\usepackage{hyperref}
```

into the preamble of your document (i.e., after the \documentclass command and before the \begin{document} command) and then produce a pdf file (either using dvipdf or directly by using pdflatex), then

- in a bonus grading table or bonus point table indexed by question number, the question numbers (or question titles, if you used \bonustitledquestion; see section **??**) in the table will be clickable links that take you to the corresponding question, and

- in a bonus grading table or bonus point table indexed by page number the page numbers in the table will be clickable links that take you to the corresponding page.

For example, if the exam has 8 questions, with each odd numbered question worth a total of 10 regular points and each even numbered question worth a total of 5 bonus points, and you type

```
\begin{center}
  \bonusgradetable[h][questions]
\end{center}
```

then you'll get

Question:	1	2	3	4	5	6	7	8	Total
Bonus Points:	0	5	0	5	0	5	0	5	20
Score:									

9.8 Combined grading tables and combined point tables

There are commands for producing *combined* grading and point tables, both partial and full, that tabulate both regular points and bonus points (see section **??**). These commands, and the non-bonus and bonus commands to which they correspond, are

Non-Bonus points only	Bonus points only	Combined
\gradetable	\bonusgradetable	\combinedgradetable
\pointtable	\bonuspointtable	\combinedpointtable
\partialgradetable	\partialbonusgradetable	\partialcombinedgradetable
\partialpointtable	\partialbonuspointtable	\partialcombinedpointtable

The first two commands in each column take two optional arguments, the first being either [v] or [h] and the second being either [questions] or [pages]. The last two commands in each column take one required argument, the name of the grading range (defined using the \begingradingrange and \endgradingrange commands; see section **??**), and then the same two optional arguments as the other commands (the first being either [v] or [h] and the second being either [questions] or [pages]).

Just as is described in section **??** for their regular points and section **??** for bonus points, if you put the command

<center>\usepackage{hyperref}</center>

into the preamble of your document (i.e., after the `\documentclass` command and before the `\begin{document}` command) and then produce a pdf file (either using dvipdf or directly by using pdflatex), then

- in a combined grading table or combined point table indexed by question number, the question numbers (or question titles, if you used either `\titledquestion` (see section **??**) or `\bonustitledquestion` (see section **??**)) in the table will be clickable links that take you to the corresponding question, and

- in a combined grading table or combined point table indexed by page number the page numbers in the table will be clickable links that take you to the corresponding page.

For example, if the exam has 8 questions, with each odd numbered question worth a total of 10 regular points and each even numbered question worth a total of 5 bonus points, and you type

```
\begin{center}
  \combinedgradetable[h][questions]
\end{center}
```

then you'll get

Question:	1	2	3	4	5	6	7	8	Total
Points:	10	0	10	0	10	0	10	0	40
Bonus Points:	0	5	0	5	0	5	0	5	20
Score:									

9.9 Changing the total points in a table

There are commands for changing the total points and total bonus points in grading and point tables, so that the stated point total will not equal the sum of the point values in the table. These commands are intended for exams in which the students are required to do some subset of the problems, but not all of them, and so the total number of points possible on the exam is less than the sum of the points for all of the questions. The commands are

<center>\settabletotalpoints
\settabletotalbonuspoints</center>

Each of those commands takes one argument. After giving the command

<center>\settabletotalpoints{number}</center>

any grading or point table (regular or combined, partial or full) will list the total points as `number` instead of the actual total number of points in the table. After giving the command

<center>Page 85</center>

$$\verb|\settabletotalbonuspoints{number}|$$

any grading or point table (bonus or combined, partial or full) will list the total bonus points as `number` instead of the actual total number of bonus points in the table.

To have these commands affect only a single table, confine the command and the command to create the table inside of a group (possibly by just placing those commands inside of a `center` environment). For example, if an exam has 8 questions, each worth 10 points, and the students are required to do any 6 of the 8, then the commands

```
\begin{center}
  \settabletotalpoints{60}
  \gradetable[h][questions]
\end{center}
```

will produce

Question:	1	2	3	4	5	6	7	8	Total
Points:	10	10	10	10	10	10	10	10	60
Score:									

and no other tables will be affected by that `\settabletotalpoints` command.

9.10   Customizing the tables

There are three ways in which you can customize the appearance of grading tables and point tables:

- You can change the words (and the fonts) that appear in the table.

- You can change the minimum width of the blank cells into which you will write the scores.

- You can change the value of `\baselinestretch` used for the table.

For all grading and point tables:

`\cellwidth{length}`	sets the minimum width of the blank cells to `length`
`\gradetablestretch{number}`	uses `number` as the `\baselinestretch`

For vertical non-bonus tables (i.e., tables created by `\gradetable[v]`, `\pointtable[v]`, `\partialgradetable{rangename}[v]`, or `\partialpointtable{rangename}[v]`):

Command	Effect
`\vqword{text}`	substitutes `text` for "Question"
`\vpgword{text}`	substitutes `text` for "Page"
`\vpword{text}`	substitutes `text` for "Points"
`\vsword{text}`	substitutes `text` for "Score"
`\vtword{text}`	substitutes `text` for "Total:"

For horizontal non-bonus tables (i.e., tables created by \gradetable[h], \pointtable[h], \partialgradetable{rangename}[h], or \partialpointtable{rangename}[h]):

Command	Effect
\hqword{text}	substitutes text for "Question:"
\hpgword{text}	substitutes text for "Page:"
\hpword{text}	substitutes text for "Points:"
\hsword{text}	substitutes text for "Score:"
\htword{text}	substitutes text for "Total"

For vertical bonus tables (i.e., tables created by \bonusgradetable[v], \bonuspointtable[v], \partialbonusgradetable{rangename}[v], or \partialbonuspointtable{rangename}[v]):

Command	Effect
\bvqword{text}	substitutes text for "Question"
\bvpgword{text}	substitutes text for "Page"
\bvpword{text}	substitutes text for "Bonus Points"
\bvsword{text}	substitutes text for "Score"
\bvtword{text}	substitutes text for "Total:"

For horizontal bonus tables (i.e., tables created by \bonusgradetable[h], \bonuspointtable[h], \partialbonusgradetable{rangename}[h], or \partialbonuspointtable{rangename}[h]):

Command	Effect
\bhqword{text}	substitutes text for "Question:"
\bhpgword{text}	substitutes text for "Page:"
\bhpword{text}	substitutes text for "Bonus Points:"
\bhsword{text}	substitutes text for "Score:"
\bhtword{text}	substitutes text for "Total"

For vertical combined tables (i.e., tables created by \combinedgradetable[v], \combinedpointtable[v], \partialcombinedgradetable{rangename}[v], or \partialcombinedpointtable{rangename}[v]):

Command	Effect
\cvqword{text}	substitutes text for "Question"
\cvpgword{text}	substitutes text for "Page"
\cvpword{text}	substitutes text for "Points"
\cvbpword{text}	substitutes text for "Bonus Points"
\cvsword{text}	substitutes text for "Score"
\cvtword{text}	substitutes text for "Total:"

For horizontal combined tables (i.e., tables created by \combinedgradetable[h], \combinedpointtable[h], \partialcombinedgradetable{rangename}[h], or \partialcombinedpointtable{rangename}[h]):

Command	Effect
\chqword{text}	substitutes text for "Question:"
\chpgword{text}	substitutes text for "Page:"
\chpword{text}	substitutes text for "Points:"
\chbpword{text}	substitutes text for "Bonus Points:"
\chsword{text}	substitutes text for "Score:"
\chtword{text}	substitutes text for "Total"

If you don't use any of these commands then you get the default values, which are defined by the commands in the following table:

Defaults for grading and point tables

```
\hqword{Question:}        \vqword{Question}        \cellwidth{2em}
\hpgword{Page:}           \vpgword{Page}           \gradetablestretch{1.5}
\hpword{Points:}          \vpword{Points}
\hsword{Score:}           \vsword{Score}
\htword{Total}            \vtword{Total:}

\bhqword{Question:}       \bvqword{Question}
\bhpgword{Page:}          \bvpgword{Page}
\bhpword{Bonus Points:}   \bvpword{Bonus Points}
\bhsword{Score:}          \bvsword{Score}
\bhtword{Total}           \bvtword{Total:}

\chqword{Question:}       \cvqword{Question}
\chpgword{Page:}          \cvpgword{Page}
\chpword{Points:}         \cvpword{Points}
\chbpword{Bonus Points:}  \cvbpword{Bonus Points}
\chsword{Score:}          \cvsword{Score}
\chtword{Total}           \cvtword{Total:}
```

For example, if you type

```
\begin{center}
  \hqword{Aufgabe Nr.:}
  \hpword{Punktzahl:}
  \htword{\textbf{Summe}}
  \hsword{Davon erreicht:}
  \cellwidth{2.2em}
  \gradetable[h][questions]
\end{center}
```

then you'll get

Aufgabe Nr.:	1	2	3	4	5	6	7	8	**Summe**
Punktzahl:	15	15	15	15	15	15	15	15	120
Davon erreicht:									

10 Changing the page margins

The exam document class arranges things so that you get one inch margins at the top, bottom, and sides no matter what size paper you use, as long as you use the corresponding document class option (`a4paper`, `a5paper`, `b5paper`, `letterpaper`, `legalpaper`, `executivepaper`, or `landscape`). You can change the sizes of these margins by using the commands that change the size of the printed area.

To change the width of the printed area, you would use the `\extrawidth` command. The `\extrawidth` command takes one argument, and enlarges the width of the printed area by the amount of the argument. It keeps the printed area centered as it changes its width. If the argument is negative, then the width of the printed area is decreased.

For example, to enlarge the left and right margins by one half inch each, you would use the command

$$\text{\\extrawidth\{-1in\}}$$

since the printed region must shrink by one inch to allow an additional one half inch on both sides. To decrease the left and right margins to three quarters of an inch each, you would use the command

$$\text{\\extrawidth\{.5in\}}$$

since the printed region must grow by one half inch to decrease both margins by one quarter of an inch.

To change the height of the printed area, you must choose whether the top or the bottom of the printed area (or possibly both) should move. The commands for this are principally intended to allow additional room for large headers and footers, and so they are called `\extraheadheight` and `\extrafootheight`. For a full description of these commands, see section **??**.

To move the top of the printed region (and any header that's present) downwards, you use the command `\extraheadheight`. This command takes one argument, and moves the top of the text and the header down by this amount (keeping the distance between the header and the text constant). Thus, to increase the top margin by three quarters of an inch, you would give the command

$$\text{\\extraheadheight\{.75in\}}$$

To decrease the top margin by one half inch, you would give the command

$$\text{\\extraheadheight\{-.5in\}}$$

The `\extraheadheight` command takes an optional argument to provide a top margin on the first page that's different from that on all other pages. For an explanation of this, see section **??**.

To move the bottom of the printed region (and any footer that's present) upwards, you use the command `\extrafootheight`. This command takes one argument, and moves the bottom of the text and the footer up by this amount (keeping the distance between the footer and the text constant). Thus, to increase the bottom margin by three quarters of an inch, you would give the command

$$\text{\texttt{\textbackslash extrafootheight\{.75in\}}}$$

To decrease the bottom margin by one half inch, you would give the command

$$\text{\texttt{\textbackslash extrafootheight\{-.5in\}}}$$

The `\extrafootheight` command takes an optional argument to provide a bottom margin on the first page that's different from that on all other pages. For an explanation of this, see section **??**.

11 Headers and footers

The following sections explain all of the commands that deal with headers and footers. There are a number of things to explain here, and so you may find it easier to skip these sections and instead look at the examples in sections **??** through **??** (on pages **??** through **??**). You can then refer back to these sections for the full story on whatever isn't clear from the examples. All of the commands described in these sections should be given in the preamble, i.e., after the `\documentclass` command and before the `\begin{document}` command.

It's also important to remember that if you use a `coverpages` environment (described in section **??**), then the commands described here affect only the pages in the main section of the exam, and not the pages of the `coverpages` environment. There are commands for headers and footers in the cover pages that are analogous to the commands described in this section; for that, see section **??**.

11.1 Page styles: Headers and/or footers

It's the `\pagestyle` command that determines whether the exam will have headers, footers, both, or neither. The contents of the header and footer are specified using the commands described in sections **??** through **??**, but it's the `\pagestyle` command that determines whether the header and footer that you construct will actually be placed onto the page. The `\pagestyle` command should be given in the preamble, i.e., after the `\documentclass` command and before the `\begin{document}` command.

To have both a header and a footer, give the command

$$\text{\texttt{\textbackslash pagestyle\{headandfoot\}}}$$

If you want every page to have a header but no footer, give the command

$$\text{\textbackslash pagestyle\{head\}}$$

To give every page a footer but no header, give the command

$$\text{\textbackslash pagestyle\{foot\}}$$

Finally, to omit both the header and the footer from the page, give the command

$$\text{\textbackslash pagestyle\{empty\}}$$

As is true for all LaTeX document classes, you can change the page style used on a single page by giving the command

$$\text{\textbackslash thispagestyle\{somestyle\}}$$

somewhere on that page (where `somestyle` is the style that you want to use on that page). This is most often needed if you use the `\maketitle` command, since that command inserts a `\thispagestyle{plain}` immediately following the title. If you use the `\maketitle` command and you want the entire document to use `\pagestyle{headandfoot}`, then you'll need to put the command `\thispagestyle{headandfoot}` immediately after the `\maketitle` command to override the `\thispagestyle{plain}` that is inserted by `\maketitle`.

The default page style is `headandfoot`. That is, if you don't give any `\pagestyle` commands, then the header and footer will appear on every page. The default header is empty, and the default footer consists of "Page n" centered in the footer (where n is the page number).

11.2 The three parts of the header

The header is specified in three parts:

- One part to be left justified.

- One part to be centered.

- One part to be right justified.

There are two different ways in which you can specify the three parts of the header. The first uses the single command `\header` to specify all three parts of the header, or the commands `\firstpageheader` and `\runningheader` to specify a different header for the first page (see section **??**). The second uses the commands `\lhead`, `\chead`, and `\rhead`, each of which can have an optional argument to specify a different header for the first page (see section **??**). All of these commands should be given in the preamble, i.e., after the `\documentclass` command and before the `\begin{document}` command.

11.2.1 Using \header, \firstpageheader and \runningheader

The command \header{Text 1}{Text 2}{Text 3} puts "Text 1" into the left justified header, "Text 2" into the centered header, and "Text 3" into the right justified header on every page. If you want the header on the first page to be different from that on the other pages, then you should use the commands \firstpageheader and \runningheader, which also take three arguments and affect either the first page or all pages except the first.

For example, to put the header

Math 115	Second Exam	July 4, 1776

on every page of the exam, you would give the command

```
\header{Math 115}{Second Exam}{July 4, 1776}
```

If you want to use a header on the first page that's different from the header used on all other pages, you would use the commands \firstpageheader and \runningheader instead of \header. For example, if you want the above header for the first page, but on all pages after the first you want to have the header

Math 115	Second Exam (Continued)	July 4, 1776

then you would give the commands

```
\firstpageheader{Math 115}{Second Exam}{July 4, 1776}
\runningheader{Math 115}{Second Exam (Continued)}{July 4, 1776}
```

You can leave one or more of the three parts empty. To have the header

Math 115	Second Exam	July 4, 1776

on the first page, with the header

Math 115		Second Exam (Continued)

on all other pages, you would give the commands

```
\firstpageheader{Math 115}{Second Exam}{July 4, 1776}
\runningheader{Math 115}{}{Second Exam (Continued)}
```

Any of the three parts of the header can have multiple lines. To specify where the line breaks should go, you just type \\. Thus, to have the header

Math 115		**First Exam**
Professor Hilbert		**July 4, 1776**

appear on every page, you would give the command

```
\header{\bfseries\large Math 115\\Professor Hilbert}
      {}
      {\bfseries\large First Exam\\July 4, 1776}
```

11.2.2   Using \lhead, \chead and \rhead

The command `\lhead{Text}` puts "Text" into the left justified part of the header on every page. The command `\lhead[Text 1]{Text 2}` puts "Text 1" into the left justified header on the first page and "Text 2" into the left justified header on all other pages. The commands `\chead` and `\rhead` have similar effects on the centered and right justified parts of the header.

For example, to put the header

Math 115   Second Exam   July 4, 1776

on every page of the exam, you would give the commands

```
\lhead{Math 115}
\chead{Second Exam}
\rhead{July 4, 1776}
```

If you want any of the three parts to have a special version to be used only on the first page, then you just include that special version as an optional argument (enclosed in square brackets) to the command. For example, if you want the above header for the first page, but on all pages after the first you want to have the header

Math 115   Second Exam (Continued)   July 4, 1776

then you would give the commands

```
\lhead{Math 115}
\chead[Second Exam]{Second Exam (Continued)}
\rhead{July 4, 1776}
```

You can leave one or more of the three parts empty. To have the header

Math 115   Second Exam   July 4, 1776

on the first page, with the header

Math 115   Second Exam (Continued)

on all other pages, you would give the commands

```
\lhead{Math 115}
\chead[Second Exam]{}
\rhead[July 4, 1776]{Second Exam Continued)}
```

Any of the three parts of the header can have multiple lines. To specify where the line breaks should go, you just type `\\`. Thus, to have the header

Math 115   **First Exam**
Professor Hilbert   **July 4, 1776**

appear on every page, you would give the commands

```
\lhead{\bfseries\large Math 115\\Professor Hilbert}
\chead{}
\rhead{\bfseries\large First Exam\\July 4, 1776}
```

Leaving extra room for multiple line headers

See section **??** for a description of the \extraheadheight command.

11.3 The three parts of the footer

The footer is composed of three parts, the whole setup being similar to that for the header (see section **??**). There are two different ways in which you can specify the three parts of the footer. The first uses the single command \footer to specify all three parts of the footer, or the commands \firstpagefooter and \runningfooter to specify a different footer for the first page (see section **??**). The second uses the commands \lfoot, \cfoot, and \rfoot, each of which can have an optional argument to specify a different footer for the first page (see section **??**). All of these commands should be given in the preamble, i.e., after the \documentclass command and before the \begin{document} command.

11.3.1 Using \footer, \firstpagefooter and \runningfooter

The command \footer{Text 1}{Text 2}{Text 3} puts "Text 1" into the left justified footer, "Text 2" into the centered footer and "Text 3" into the right justified footer on every page. If you want the footer on the first page to be different from that on the other pages, then you should use the commands \firstpagefooter and \runningfooter, which also take three arguments and affect either the first page or all pages except the first.

For example, to have an empty footer on the first page and the footer

on all pages after the first, you would give the commands

```
\firstpagefooter{}{}{}
\runningfooter{}{Page \thepage\ of \numpages}{}
```

(For an explanation of the \numpages command, see section **??**.)

11.3.2 Using \lfoot, \cfoot, and \rfoot

The command \lfoot{Text} puts "Text" into the left justified part of the footer on every page. The command \lfoot[Text 1]{Text 2} puts "Text 1" into the left justified footer on the first page and "Text 2" into the left justified footer on all other pages. The commands \cfoot and \rfoot have similar effects on the centered and right justified parts of the footer.

For example, to have an empty footer on the first page and the footer

on all pages after the first, you would give the commands

```
\lfoot{}
\cfoot{}
\rfoot[]{Page \thepage\ of \numpages}
```

(For an explanation of the `\numpages` command, see section **??**.)

Leaving extra room for multiple line footers

See section **??** for a description of the `\extrafootheight` command.

11.4   Leaving extra room for multiple line headers and footers

Headers

If you specify more than one or two lines for any part of the header, then you may want to move the header down slightly so that it doesn't run off of the top of the paper. The command for this is `\extraheadheight`. You can also use the `\extraheadheight` command to adjust the size of the text area. The `\extraheadheight` command never changes the distance between the header and the text.

For example, to move the header and the text an additional half inch down from the top of the page, you would give the command

```
\extraheadheight{.5in}
```

You can also specify a negative distance to `\extraheadheight` to move the header up closer to the top of the paper. For example, the command

```
\extraheadheight{-.25in}
```

moves the header one quarter inch closer to the top of the paper.

If you want to have a different value for `\extraheadheight` on the first page from that on the pages after the first, then use the same syntax as in the `\lhead`, `\chead`, and `\rhead` commands (see section **??**): Include an optional argument giving the extra head height for the first page, and the required argument will apply only to those pages after the first. For example, the command

```
\extraheadheight[.5in]{.25in}
```

gives a half inch of extra head height on the first page and a quarter inch of extra head height on all pages after the first. If you say

```
\extraheadheight[.5in]{}
```

then this will be interpreted as if it was

```
\extraheadheight[.5in]{0in}
```

Note that the braces *must* appear.

If you give an `\extraheadheight` command, it should be in the preamble, i.e., after the `\documentclass` command and before the `\begin{document}` command. The `\extraheadheight` command can also be used to change the size of the text region (see section **??**).

Footers

To leave extra room for multiple line footers, you use the command `\extrafootheight`. To move the footer one half inch higher up on the paper, you would give the command

$$\text{\textbackslash extrafootheight\{.5in\}}$$

If you wanted to move the footer an eighth of an inch lower down on the paper, you would give the command

$$\text{\textbackslash extrafootheight\{-.125in\}}$$

If you want to have a different value for `\extrafootheight` on the first page from that on the pages after the first, then use the same syntax as in the `\lfoot`, `\cfoot`, and `\rfoot` commands (see section **??**): Include an optional argument giving the extra foot height for the first page, and the required argument will apply only to those pages after the first. For example, the command

$$\text{\textbackslash extrafootheight[.5in]\{.25in\}}$$

gives a half inch of extra foot height on the first page and a quarter inch of extra foot height on all pages after the first. If you say

$$\text{\textbackslash extrafootheight[.5in]\{\}}$$

then this will be interpreted as if it was

$$\text{\textbackslash extrafootheight[.5in]\{0in\}}$$

Note that the braces *must* appear.

If you give an `\extrafootheight` command, it should be in the preamble, i.e., after the `\documentclass` command and before the `\begin{document}` command. The `\extrafootheight` command can also be used to change the size of the text region (see section **??**).

11.5   Horizontal rules

The `exam` document class make it easy to put a horizontal rule under the header and one above the footer. It is also easy to do this for the pages after the first page without affecting the first page.

- The command `\runningheadrule` puts a horizontal rule below the header on all pages after the first.

- The command `\firstpageheadrule` puts a rule under the header of only the first page.

- The command `\headrule` is equivalent to the two commands `\firstpageheadrule` and `\runningheadrule`.

- The command `\runningfootrule` puts a horizontal rule above the footer on all pages after the first.

- The command `\firstpagefootrule` puts a rule above the footer of only the first page.

- The command `\footrule` is equivalent to the two commands `\firstpagefootrule` and `\runningfootrule`.

For example, to have the header

Math 115	First Exam	July 4, 1776

on the first page, with the header

Math 115	First Exam	July 4, 1776

on all pages after the first, give either the commands

```
\runningheadrule
\header{Math 115}{First Exam}{July 4, 1776}
```

or the commands

```
\runningheadrule
\lhead{Math 115}
\chead{First Exam}
\rhead{July 4, 1776}
```

For a description of the command `\header` see section **??**; for a description of the commands `\lhead`, `\chead`, and `\rhead`, see section **??**.

To have no footer on the first page, and the footer

Page 3 of 5

on all pages after the first, give the commands

```
\runningfootrule
\lfoot{}
\cfoot[]{Page \thepage\ of \numpages}
\rfoot{}
```

(For an explanation of the `\numpages` command, see section **??**.)

11.6   Listing the number of pages in the exam

The `exam` document class defines the command `\numpages` so that it will expand to the number of pages in the exam. Thus, to have the footer

Page 97 of **??**

you should either give the command

```
\footer{}{Page \thepage\ of \numpages}{}
```

or the commands

```
\lfoot{}
\cfoot{Page \thepage\ of \numpages}
\rfoot{}
```

For a description of the command `\footer` see section **??**; for a description of the commands `\lfoot`, `\cfoot`, and `\rfoot`, see section **??**.

Note that if your document has a `coverpages` environment (see section **??**), then those pages will not be counted in `\numpages`; the `exam` document class defines the command `\numcoverpages` so that it will expand to the number of cover pages in the exam. If there is no `coverpages` environment, then `\numcoverpages` expands to 0. The `exam` class also defines the command `\totalnumpages`, which expands to the sum of `\numpages` and `\numcoverpages`. Note that if there are pages preceding a `coverpages` environment, then those pages will not be counted by `\totalnumpages`.

As with all other cross referencing commands in LaTeX, you'll have to run the file through LaTeX *twice* to be sure that `\numpages`, `\numcoverpages`, and `\totalnumpages` are correct.

11.7   Treating the last page differently

If you want to vary the text that appears in the header or footer on the last page of the exam, you should use the command `\iflastpage`. The command

```
\iflastpage{Text 1}{Text 2}
```

expands to 'Text 1' on the last page and to 'Text 2' on all pages before the last. Thus, to have the footer

Please go on to the next page. . .

on all pages before the last page and the footer

End of exam

on the last page, you should give the command

```
\footer{}
        {\iflastpage{End of exam}{Please go on to the next page\ldots}}
        {}
```

or the commands

```
\lfoot{}
\cfoot{\iflastpage{End of exam}{Please go on to the next page\ldots}}
\rfoot{}
```

For a description of the command \footer see section **??**; for a description of the commands \lfoot, \cfoot, and \rfoot, see section **??**.

As with all other cross referencing commands in LaTeX, you'll have to run the file through LaTeX *twice* to be sure that \iflastpage correctly detects the last page.

11.8   Treating odd and even numbered pages differently

If you'd like odd and even numbered pages to be treated differently (perhaps because you'll be printing onto both sides of the paper), you should use the \oddeven command. The command

$$\oddeven\{Text\ 1\}\{Text\ 2\}$$

expands to 'Text 1' on odd numbered pages and to 'Text 2' on even numbered pages.

For example, to have the page number printed in the right head on odd numbered pages and in the left head on even numbered pages, you should give the command

```
\header{\oddeven{}{\thepage}}%
        {}%
        {\oddeven{\thepage}{}}
```

or the commands

```
\lhead{\oddeven{}{\thepage}}
\rhead{\oddeven{\thepage}{}}
\chead{}
```

If you want the footer of the even numbered pages to be empty and the footer of the odd numbered pages to contain the centered message "Please continue...", except that the last page of the exam should have an empty footer whether its page number is even or odd, then you should give the command

```
\footer{}
        {\oddeven{\iflastpage{}{Please continue\ldots}}{}}
        {}
```

or the commands

```
\lfoot{}
\rfoot{}
\cfoot{\oddeven{\iflastpage{}{Please continue\dots}}{}}
```

(see section **??** for an explanation of `\iflastpage`).

The `\oddeven` command can be used reliably only in headers and footers. This is because LaTeX generally processes more text than can fit on the current page before chooses a page break it outputs a page. When the `\oddeven` command is encountered it will act as though it will appear on the current page whether it will actually be printed on that page or on the following page; in headers and footers this never creates a problem.

11.9 Questions that span multiple pages

The exam document class provides the commands

- `\ifcontinuation` and `\ContinuedQuestion` to enable headers and footers that announce whether the current page is continuing a question begun on an earlier page and, if so, the number of that question (see section **??**), and

- `\ifincomplete` and `\IncompleteQuestion` to enable headers and footers that announce whether the question at the bottom of the current page continues onto the next page and, if so, the number of that question (see section **??**).

These commands are only guaranteed to work reliably in headers and footers. If you use any of them elsewhere, they may be fooled by LaTeX's practice of typesetting a bit too much material to fit on a page before it chooses a page break and ships out the page. They also assume that there is only one `questions` environment in the entire exam.

11.9.1 Questions continuing from the previous page

Headers and footers can announce whether the current page continues a question begun on an earlier page. The command

$$\text{\texttt{\textbackslash ifcontinuation\{Text 1\}\{Text 2\}}}$$

expands to 'Text 1' if the current page begins with a continuation of a question begun on an earlier page, and to 'Text 2' otherwise. If the current page does continue a question begun on an earlier page, then the command

$$\text{\texttt{\textbackslash ContinuedQuestion}}$$

expands to the number of that question.

For example, to have the header

First Exam   Page 4

on all pages that begin a new question and the header

on all pages that continue a question begun on a previous page, you would give the commands

```
\lhead{\ifcontinuation{Question \ContinuedQuestion\ continues\ldots}{}}
\chead{First Exam}
\rhead{Page \thepage}
```

(See section **??** for an explanation of `\lhead`, `\chead` and `\rhead`.)

The `\ifcontinuation` command figures out which text to use by checking whether there is a `\question` command appearing on the page before any of the commands `\part`, `\subpart`, `\subsubpart`, `\choice`, or `\CorrectChoice`, and this works well for most pages. However, the `\ifcontinuation` command can make mistakes on pages on which none of those commands appear. The default is to assume that a page with none of those commands continues a question begun on an earlier page, but there are two commands you can use to tell the `\ifcontinuation` command that it should *not* assume that:

- the `\nomorequestions` command can be used to mark the point at which the last question ends. This can be useful if you want to include supplementary material (e.g., tables or figures) at the end of the exam but you don't want that material to be described as continuing the last question. The `\nomorequestions` command also tells the `\ifincomplete` command (see section **??**) that all questions are now complete.

- The `\noquestionsonthispage` command tells the `\ifcontinuation` command (and the `\ifincomplete` command; see section **??**) that this page does not continue a question begun on an earlier page. This is similar to the job done by the `\nomorequestions` command for the pages that follow the end of all of the questions. Note that if you're tempted to use this command on a page that follows the end of all of the questions, then you should probably use the command `\nomorequestions` instead.

Thus, in more detail, the command `\ifcontinuation{Text 1}{Text 2}`

- expands to 'Text 2' if

  - a `\question` appears on this page before any `\part`, `\subpart`, `\subsubpart`, `\choice`, or `\CorrectChoice`, or
  - the command `\noquestionsonthispage` has been given on this page, or
  - the current page is before the page containing question number 1, or
  - the current page is later than a page with the `\nomorequestions` command,

- and otherwise it expands to 'Text 1'.

11.9.2 Questions that continue onto a later page

Headers and footers can announce whether a question on the current page continues onto a later page. The command

$$\text{\textbackslash ifincomplete\{Text 1\}\{Text 2\}}$$

expands to 'Text 1' if the last question begun on or before the current page continues onto a page after this one, and to 'Text 2' otherwise. If the last question begun on or before the current page does continue onto a later page, then the command

$$\text{\textbackslash IncompleteQuestion}$$

expands to the number of that question.

For example, to have the footer

Question 3 continues...

---

on all pages that end with a question that will be continued onto the next page, the footer

---
End of Exam

---

on the last page, and the footer

Exam continues...

---

on all other pages, you would give the commands

```
\footrule
\lfoot{}
\newcommand{\continues}{\ifincomplete
                  {Question \IncompleteQuestion\ continues\ldots}
                  {Exam continues\ldots}}
\cfoot{\iflastpage{End of Exam}{\continues}}
\rfoot{}
```

(See section **??** for an explanation of `\lfoot`, `\cfoot` and `\rfoot`, and section **??** for an explanation of `\iflastpage`).

There are two situations in which you may have to give an additional command for the `\ifincomplete` command to correctly decide if the current question is incomplete:

1. The `\ifincomplete` command expands to 'Text 2' if there is a `\part`, `\subpart`, `\subsubpart`, `\choice`, or `\CorrectChoice` command belonging to this question on the following page. For those situations in which the current question flows onto the next page, but there is no `\part`, `\subpart`, `\subsubpart`, `\choice`, or `\CorrectChoice` belonging to this question on that page, you should give the command

at the end of the text of the question to inform the \ifincomplete command that some portion of the question appears on that following page.

2. If there are pages on which none of those commands appear, the default is to assume that that page continues a question begun on an earlier page. There are two commands that you can use to tell the \ifincomplete command that it should *not* assume that:

   - the \nomorequestions command can be used to mark the point at which the last question ends. This can be useful if you want to include supplementary material (e.g., tables or figures) at the end of the exam but you don't want the last question on the exam to be described as incomplete. The \nomorequestions command also tells the \ifcontinuation command (see section ??) that all questions are now complete.

   - The \noquestionsonthispage command tells the \ifincomplete command (and the \ifcontinuation command; see section ??) that this page does not contain any incomplete questions, and does not continue a question begun on an earlier page. This is similar to the job done by the \nomorequestions command for the pages that follow the end of all of the questions. Note that if you're tempted to use this command on a page that follows the end of all of the questions, then you should probably use the command \nomorequestions instead.

If you give the command \noquestionsonthispage on a page, then

   - an \ifcontinuation command on that page will expand to its second argument,

   - an \ifincomplete on that page will expand to its second argument, and

   - an \ifincomplete command on an earlier page will not assume that a question from that earlier page continues onto this page.

The way that this command affects the \ifincomplete command on earlier pages is as follows: If there is a page with no \question, \part, \subpart, \subsubparts, \choice, \CorrectChoice, or \addquestionobject commands, then the last page before that with a \question (or \part, etc.) would normally be deemed to have an incomplete question; if, however, the page with no \question (or \part, etc.) (along with all adjacent pages with no \question or \part etc.) has a \noquestionsonthispage command, then that last page with a \question (or \part, etc.) will not be deemed incomplete.

11.10   Examples

11.10.1   Example:

To have the header

Math 115   First Exam   July 4, 1776

on the first page, the header

Math 115   First Exam, Page 2 of 5   July 4, 1776

on all pages after the first, and no footer on any page, give the commands

```
\pagestyle{head}
\runningheadrule
\firstpageheader{Math 115}{First Exam}{July 4, 1776}
\runningheader{Math 115}
              {First Exam, Page \thepage\ of \numpages}
              {July 4, 1776}
```

Alternatively, you could give the commands

```
\pagestyle{head}
\runningheadrule
\lhead{Math 115}
\chead[First Exam]{First Exam, Page \thepage\ of \numpages}
\rhead{July 4, 1776}
```

11.10.2 Example:

To have the header

Math 115   First Exam   July 4, 1776

on the first page, no header on the pages after the first, no footer on the first page, and the footer

---

Math 115   First Exam   Page 2 of 5

on all pages after the first, give the commands

```
\pagestyle{headandfoot}
\runningfootrule
\firstpageheader{Math 115}{First Exam}{July 4, 1776}
\runningheader{}{}{}
\firstpagefooter{}{}{}
\runningfooter{Math 115}{First Exam}{Page \thepage\ of \numpages}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\runningfootrule
\lhead[Math 115]{}
\chead[First Exam]{}
\rhead[July 4, 1776]{}
\lfoot[]{Math 115}
\cfoot[]{First Exam}
\rfoot[]{Page \thepage\ of \numpages}
```

11.10.3 Example:

To have the header

Mathematics 115
First Exam, July 4, 1776   **Name:** _____

on the first page, the header

Mathematics 115
First Exam, July 4, 1776

on all pages after the first, an empty footer on the first page, and the footer

Page 2

on all pages after the first, give the commands

```
\pagestyle{headandfoot}
\firstpageheader{\large\bfseries Mathematics 115\\
                 First Exam, July 4, 1776}
              {}
              {\large\bfseries Name:\enspace\makebox[2in]{\hrulefill}}
\runningheader{\large\bfseries Mathematics 115\\
            First Exam, July 4, 1776}{}{}
\firstpagefooter{}{}{}
\runningfooter{}{Page \thepage}{}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\lhead{\large\bfseries Mathematics 115\\ First Exam, July 4, 1776}
\chead{}
\rhead[\large\bfseries Name:\enspace\makebox[2in]{\hrulefill}]{}
\lfoot{}
\cfoot[]{Page \thepage}
\rfoot{}
```

11.10.4   Example:

To have the header

<div align="center">
Wellesley College
Second Semester Final Examination, Spring 1993
Mathematics 115
</div>

on the first page, the header

<div align="center">
Wellesley College
Second Semester Final Examination, Spring 1993
Mathematics 115 (Continued)
</div>

on all pages after the first, the footer

Page 3 of 10   Please go on to the next page...

on all pages *except the last* page, and the footer

Page 10 of 10   End of exam.

on the last page, give the commands

```
\pagestyle{headandfoot}
\extraheadheight{.25in}
\firstpageheader{}
                {Wellesley College\\
                  Second Semester Final Examination, Spring 1993\\
                  Mathematics 115}
                {}
\runningheader{}
              {Wellesley College\\
                Second Semester Final Examination, Spring 1993\\
                Mathematics 115 (Continued)}
              {}
\footer{}
       {Page \thepage\ of \numpages}
       {\iflastpage{End of exam.}{Please go on to the next page\ldots}}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\extraheadheight{.25in}
\lhead{}
\chead[Wellesley College\\
```

```
        Second Semester Final Examination, Spring 1993\\
        Mathematics 115]
      {Wellesley College\\
        Second Semester Final Examination, Spring 1993\\
        Mathematics 115 (Continued)}
\rhead{}
\lfoot{}
\cfoot{Page \thepage\ of \numpages}
\rfoot{\iflastpage{End of exam.}{Please go on to the next page\ldots}}
```

11.10.5   Example:

To have the header

<div align="center">

Wellesley College
Second Semester Final Examination, Spring 1993
Mathematics 115

</div>

on the first page, the header

Mathematics 115 (Continued)   Spring, 1993

on all pages after the first, the footer

Page 3 of 10   Please go on to the next page...

on all pages *except the last* page, and the footer

Page 10 of 10   End of exam.

on the last page, give the commands

```
\pagestyle{headandfoot}
\extraheadheight[.25in]{}
\firstpageheader{}
                {Wellesley College\\
                  Second Semester Final Examination, Spring 1993\\
                  Mathematics 115}
                {}
\runningheader{Mathematics 115 (Continued)}{}{Spring, 1993}
\footer{}
      {Page \thepage\ of \numpages}
      {\iflastpage{End of exam.}{Please go on to the next page\ldots}}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\extraheadheight[.25in]{}
\lhead[]{Mathematics 115 (Continued)}
\chead[Wellesley College\\
      Second Semester Final Examination, Spring 1993\\
      Mathematics 115]
    {}
\rhead[]{Spring, 1993}
\lfoot{}
\cfoot{Page \thepage\ of \numpages}
\rfoot{\iflastpage{End of exam.}{Please go on to the next page\ldots}}
```

11.10.6 Example:

To have the header

Math 115	First Exam	July 4, 1776

on the first page, the header

Question 3 continues...	First Exam	Page 3 of 10

on all pages after the first that continue a question begun on an earlier page, the header

	First Exam	Page 3 of 10

on all pages after the first that don't continue a question begun on an earlier page, the footer

<div align="right">Question 6 continues on the next page...</div>

on all pages whose last question continues onto the following page, and no footer on pages that don't have a question that continues onto the following page, give the commands

```
\pagestyle{headandfoot}
\runningheadrule
\newcommand{\continuedmessage}{%
  \ifcontinuation{Question \ContinuedQuestion\ continues\ldots}{}%
}
\firstpageheader{Math 115}{First Exam}{July 4, 1776}
\runningheader{\continuedmessage}
             {First Exam}
             {Page \thepage\ of \numpages}
\footer{}
       {}
       {\ifincomplete{Question \IncompleteQuestion\ continues
         on the next page\ldots}{}}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\runningheadrule
\newcommand{\continuedmessage}{%
  \ifcontinuation{Question \ContinuedQuestion\ continues\ldots}{}%
}
\lhead[Math 115]{\continuedmessage}
\chead[First Exam]{First Exam}
\rhead[July 4, 1776]{Page \thepage\ of \numpages}
\lfoot{}
\cfoot{}
\rfoot{\ifincomplete{Question \IncompleteQuestion\ continues
        on the next page\ldots}{}}
```

11.10.7   Example:

To have the header

Math 115   Second Exam   July 4, 1776

on the first page, the header

Second Exam   July 4, 1776

on all pages after the first, no footer on the first page, and the footer

Page 3 of 5   Points earned: _____
                                                                        out of a possible 20 points

on all pages after the first, give the commands

```
\pagestyle{headandfoot}
\firstpageheader{Math 115}{Second Exam}{July 4, 1776}
\runningheader{Second Exam}{}{July 4, 1776}
\runningfooter{Page \thepage\ of \numpages}
              {}
              {Points earned: \makebox[.5in]{\hrulefill}\\
                out of a possible \pointsonpage{\thepage} points}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\lhead[Math 115]{Second Exam}
\chead[Second Exam]{}
\rhead{July 4, 1776}
\lfoot[]{Page \thepage\ of \numpages}
\cfoot{}
\rfoot[]{Points earned: \makebox[.5in]{\hrulefill}\\
        out of a possible \pointsonpage{\thepage} points}
```

11.10.8 Example:

To have the header

Math 115   Second Exam   July 4, 1776

on the first page, the header

Second Exam   July 4, 1776

on all odd numbered pages after the first, the header

Question 3 continues. . .   Math 115

on all even numbered pages that continue a question begun on an earlier page, the header

Math 115

on all even numbered pages that don't continue a question begun on an earlier page, the footer

Page 5 of 10
Question 6 continues. . .

on all odd numbered pages that have a question that continues onto the following page, the footer

Page 5 of 10

on all odd numbered pages that don't have a question that continues onto the following page, and the footer

Page 4 of 10

on all even numbered pages, give the commands

```
\pagestyle{headandfoot}
\newcommand{\continuedmessage}{%
  \ifcontinuation{Question \ContinuedQuestion\ continues\ldots}{}%
}
\newcommand{\oddrightfoot}{%
  \ifincomplete{Page \thepage\ of \numpages\\
                Question \IncompleteQuestion\ continues\ldots}%
            {Page \thepage\ of \numpages}
}
\firstpageheader{Math 115}{Second Exam}{July 4, 1776}
```

```
\runningheader{\oddeven{}{\continuedmessage}}
              {\oddeven{Second Exam}{Math 115}}
              {\oddeven{July 4, 1776}{}}
\footer{\oddeven{}{Page \thepage\ of \numpages}}
       {}
       {\oddeven{\oddrightfoot}{}}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\newcommand{\continuedmessage}{%
  \ifcontinuation{Question \ContinuedQuestion\ continues\ldots}{}%
}
\newcommand{\oddrightfoot}{%
  \ifincomplete{Page \thepage\ of \numpages\\
                 Question \IncompleteQuestion\ continues\ldots}%
               {Page \thepage\ of \numpages}
}
\lhead[Math 115]{\oddeven{}{\continuedmessage}}
\chead{\oddeven{Second Exam}{Math 115}}
\rhead{\oddeven{July 4, 1776}{}}
\lfoot{\oddeven{}{Page \thepage\ of \numpages}}
\cfoot{}
\rfoot{\oddeven{\oddrightfoot}{}}
```

12   Cover pages

There is a `coverpages` environment that allows you to have one or more pages before page 1 of the exam. By default, there are no headers or footers printed on the cover pages, but if you put the page number into the headers and/or footers (using the commands described in section **??**), the page numbers of cover pages are printed in roman numerals.

   The `coverpages` environment must begin and end *before* the beginning of the `questions` environment. You begin the environment with the command

$$\text{\textbackslash begin\{coverpages\}}$$

and you end it with the command

$$\text{\textbackslash end\{coverpages\}}$$

In between those two commands you can put whatever you want, except that you are not allowed to begin the `questions` environment until you've ended the `coverpages` environment. The command `\begin{coverpages}` sets the page number to 1 and causes any page numbers printed (using the commands described in section **??**) to appear as roman numerals. The command `\end{coverpages}` causes the current page to end, sets the page number of the following page to 1, and changes page numbering back to arabic numerals.

12.1 Headers and footers

By default, the headers and footers on the cover pages are empty. If you'd like to have headers and/or footers on the cover pages, there are commands to create them that are completely analogous to the commands described in section **??** for headers and footers in the main part of the document. The commands for headers and footers in cover pages and the corresponding commands for the main exam pages are:

Cover Pages Commands	Main Pages Commands
\coverheader	\header
\coverrunningheader	\runningheader
\coverfirstpageheader	\firstpageheader
\coverlhead	\lhead
\coverchead	\chead
\coverrhead	\rhead
\coverfooter	\footer
\coverrunningfooter	\runningheader
\coverfirstpagefooter	\firstpageheader
\coverlfoot	\lfoot
\covercfoot	\cfoot
\coverrfoot	\rfoot
\coverextraheadheight	\extraheadheight
\coverextrafootheight	\extrafootheight

The commands \coverlhead, \coverchead, \coverrhead, \coverlfoot, \covercfoot, \coverrfoot, \coverextraheadheight, and \coverextrafootheight all all take the same optional arguments (for special treatment of page number 1) as the corresponding commands for the main pages. For an explanation of these commands, see section **??**.

12.2 Listing the number of cover pages

The `exam` document class defines the command \numcoverpages so that it will expand to the number of cover pages in the exam. If there is no `coverpages` environment, then \numcoverpages expands to 0. The `exam` class also defines the command \totalnumpages, which expands to the sum of \numpages and \numcoverpages. *Note:* if there are pages preceding a `coverpages` environment, then those pages will not be counted by \totalnumpages.

For an example, to have the footer

on all cover pages you should either give the command

```
\coverfooter{}{Page \thepage\ of \romannumeral\numcoverpages}{}
```

or the commands

```
\coverlfoot{}
\covercfoot{Page \thepage\ of \romannumeral\numcoverpages}
\coverrfoot{}
```

As with all other cross referencing commands in LaTeX, you'll have to run the file through LaTeX *twice* to be sure that `\numpages`, `\numcoverpages`, and `\totalnumpages` are correct.