Using the exam document class

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This is the documentation for version 2.2 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. Most of what's done by the `exam` document class can also be accomplished by using `fancyheadings.sty`, adjusting LaTeX's page layout parameters (perhaps by using `fullpage.sty`), and making careful use of the `list` environment, but the `exam` document class tries to make all this as simple as possible.

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 very flexible headers and footers, and change the margins. In particular:

- The class will automatically format and number the questions, parts of questions, subparts of questions, and subsubparts of questions, while making it easy to refer to specific questions by number in any special directions you need to print on the exam.

- 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.

- 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. You can also have the class print a grading table indexed either by question number or by page number.

- You can specify the header in three parts: The left head, the center head, and the right head. The left head is left justified, the center head is centered, and the right head is right justified, and one or all of these can be omitted.

- The footer is also specified in three parts: Left justified, centered, and right justified.

- The header and footer for the first page can be different from the ones used on other pages.

- Both headers and footers can contain more than one line. To accommodate headers and footers with many lines, simple commands are provided to increase the parts 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.

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

- 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).

- You can have a horizontal rule at the base of the header and/or at the top of the footer.

2 License

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

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

3 The `documentclass` command

To use the `exam` document class, you should specify `exam` as your main document class. For example, if you want to use 12 point type, then your `documentclass` command should be

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

If you would also like to use some of the features of $\mathcal{AMS}$-LaTeX, then you should use the commands

```
\documentclass[12pt]{exam}
\usepackage{amsmath}
```

If you will be typing solutions into the exam (see section 5.9) 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

```
\documentclass[answers]{exam}
```

or

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

This is optional, though; you can accomplish the same thing by giving the command `\printanswers` (see section 5.9).

4   Asking for the student's name

This isn't anything specific to the exam document class, but it's worth mentioning because it isn't obvious. If you're leaving space for the answers on the question pages (see section 5.7), 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}

\hbox to \textwidth{Name and section:\enspace\hrulefill}

\vspace{0.2in}

\hbox to \textwidth{Instructor's name:\enspace\hrulefill}
```

after the `\begin{document}` command and before the `\begin{questions}` command (see section 5), 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: _____

5   Questions

To type the questions in the exam, you use the questions environment. Each question is then begun with the command `\question`, and the questions will be 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.

5.1   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.

5.2   Point values for the questions

Each of the commands `\question`, `\part`, `\subpart` and `\subsubpart` take an optional argument, which is the number of points for that question, part, subpart, or subsubpart. (By default, the point values are enclosed in parentheses, but the parentheses can be replaced with either square brackets or a box; for this, see section 5.2.2.)

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 5.2.6.

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 5.2.3.)

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") inside the parentheses with the point values, see the `\marginpointname` command in section 5.2.3.)

   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)

5.2.1   Half points

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

<div align="center">

`\half`

</div>

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

<div align="center">

`\usehorizontalhalf`

</div>

after which the printed appearance of half 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

<div align="center">

`\useslantedhalf`

</div>

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

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

$$\texttt{\textbackslash bracketedpoints}$$

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

$$\texttt{\textbackslash boxedpoints}$$

For example, if you give the command \boxedpoints, 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 give the commands \boxedpoints and \pointsinmargin, then the above questions will produce

⏐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.

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

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

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 a word automatically inserted following the point values when using either \pointsinmargin or \pointsinrightmargin, see the \marginpointname command in section 5.2.3.

5.2.3 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 the word "point" if the number of points is 1 and by the word "points" otherwise. That is, the default is \nopointsinmargin and \noboxedpoints (see sections 5.2 and 5.2.2), and if you type

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

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

then you'll get

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

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

The way this is achieved is:

- There is a command

```
\points
```

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

- There is a command

<div align="center">

`\pointname{Text}`

</div>

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

<div align="center">

`\pointname{ \points}`

</div>

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

You can modify this setup by using the command `\pointname`, but there is also a command

<div align="center">

`\pointpoints{SingularText}{PluralText}`

</div>

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

<div align="center">

`\pointpoints{Punkt}{Punkte}`

</div>

then typing the questions above would result in

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

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

and if you give the command

<div align="center">

`\pointpoints{mark}{marks}`

</div>

then typing the questions above would result in

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

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

There is a shortcut for that; the command

<div align="center">

`\marksnotpoints`

</div>

expands to `\pointpoints{mark}{marks}`.

For example, if you give the command

<div align="center">

`\pointname{\%}`

</div>

and then type

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

then you'll get

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

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, of course, you've also given the command `\boxedpoints` (see section 5.2.2), 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{}
```

5.2.4   Using `marginpointname` and enlarging the margins

The default margins are not very large, and so if you use `\marginpointname` (see section 5.2.3) 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, 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 7 for a discussion of the `\extrawidth` command.)

5.2.5 Questions that begin with a parts environment

One thing to keep in mind is that *only one point value can appear on a line, and it will be the last one to be placed there.* This matters only if a question begins with a parts environment, or if a part begins with a subparts environment, or if a subpart begins with a subsubparts environment. In any of these cases, the question number and part number (or the part number and subpart number, etc.) will appear on the same line, and if both of these commands include an optional point value, *only the last one given will be used.* For example, if you type

```
\begin{questions}
\question[10]
\begin{parts}
\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

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"?

Notice that the 10 points for the entire question are never mentioned anywhere, since they would have appeared on the same line with the 5 points for the first part, and the 5 points for the part were placed later. This is true whether \pointsinmargin, \pointsinrightmargin, or \nopointsinmargin is in effect. In addition, if you've given the command \addpoints (see section 5.3), then this question will have 20 points assigned to it (10 for the question itself plus 5 for each of the two parts) even though the 10 for the question itself will not be printed.

5.2.6 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

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

commands.

If you give the command

$$\text{\pointsdroppedatright}$$

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 5.2.9), 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). Thus, the formatting can be changed by giving the commands `\bracketedpoints`, `\boxedpoints`, or `\marginpointname` (see section 5.2.3). The command `\droppoints` actually works this way even if one of the commands

<p style="text-align:center">`\nopointsinmargin`, `\pointsinmargin`, or `\pointsinrightmargin`</p>

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)

   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)

5.2.7 Adding up the points for each question

If you give the command \addpoints (see section 5.3), then you can use the command

\droptotalpoints

to put into the right margin the total number of points for the current question (including the points for all parts, subparts, and subsubparts). The command \droptotalpoints 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. \droptotalpoints prints the total points for the current question in the right margin, formatted by default as:

Total for Question 2: 25

(Note: The number of points is followed by the value of \marginpointname, which by default is empty.)

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

\totalformat

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 6.2 for a discussion of the \pointsofquestion command.) For example, if you give the command

\totalformat{Question \thequestion: \totalpoints \points}

then the total points will be printed in the format

Question 2: 25 points

and if you give the command

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

then the total points will be printed as

Total: 25

Thus, if you've given the commands

\addpoints
\bracketedpoints
\pointdroppedatright

and you type

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

<div align="right">Total for Question 1: [20]</div>

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

```
\pointsinmargin
\pointsinrightmargin
\nopointsinmargin
```

whenever you want to switch.

5.2.8 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 \marginpointsep from the left edge of the text area. The default value of \marginpointsep is the result of the command

  ```
  \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

  ```
  \setlength{\rightpointsmargin}{1cm}
  ```

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

5.2.9 Custom question number lines

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

$$\texttt{\textbackslash qformat\{Format specification\}}$$

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, and

- `\thepoints`, which expands to the number of points followed by the value of the last `\pointname` command (if points are specified for the question) or to nothing (if no points were specified). (For a discussion of the `\pointname` command, see section 5.2.3)

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</div>

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

5.2.10 Adding up the points for each question

You can also combine `\qformat` with the `\pointsofquestion` command (see section 6.2):
If you assign points only to parts, subparts, and subsubparts of questions, but none to the
questions themselves, and you give the commands

```
\addpoints
\qformat{Question \thequestion\dotfill
        \emph{(\pointsofquestion{\arabic{question}} \points)}}
```

then you can type

```
\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}
```

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?

5.3 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

<div align="center">

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

</div>

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 give the command

<div align="center">

`\addpoints`

</div>

then the class will add the total number of points that you've given to all of the questions,
parts, and subparts of the exam, and make that total available in the macro

<div align="center">

`\numpoints`

</div>

(If you do give the command `\addpoints`, then the total number of points will also be displayed on the screen when you run LaTeX, and placed into the `.log` file as well.) Thus, if you give the command `\addpoints` (after the `\documentclass` command and before the `\begin{document}` command), and then type

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

after the `\begin{document}` command, then you'll get

<div align="center">

This exam has 8 questions, for a total of 120 points.

</div>

Warning: If you give the command `\addpoints`, your point values for questions, parts, and subparts must not contain anything other than digits. For example, if you *don't* give the command `\addpoints`, then you can type

<div align="center">

`\question[10\%]`

</div>

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 5.2.3).

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

<div align="center">

`\noaddpoints`

</div>

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

If you give the command `\addpoints`, then you can also use the command `\gradetable` to print a grading table (see section 6) or the command `\pointsofquestion` to list the total points for individual questions of the exam (see section 6.2).

5.4   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 1. Question number 2 has both a good part (part a) and a bad part (part b).

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.

5.5 Including special instructions for a group of questions

There are two commands provided for including special instructions for specific questions: `\uplevel` and `\fullwidth`. These commands allow you to give instructions that will be set with the left indentation appropriate for the scope of the instructions.

For example, 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?

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

Questions 2 through 4 should be evaluated completely, not just approximated.

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

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

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

    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 the earlier part of 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 the earlier part of 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.

5.6   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 5.5), and the other way uses the standard `\part` and `\section` commands.

5.6.1   Using `fullwidth` and `uplevel`

To place a section name in the exam, just use a `\fullwidth` command (see section 5.5) 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\bf 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\bf 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.

5.6.2 Using the standard sectioning commands

The exam documentclass is built upon the standard article documentclass, and so the sectioning commands used with the article documentclass can be used here as well. In particular, you can give the commands `\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 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).

5.7 Leaving space for the answers

5.7.1 Leaving blank space

To leave a specific amount of 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 any 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 equally distribute the blank space among the questions on the page, then just put `\vspace*{\fill}` after each question on the page and use `\newpage` to end the page.

You can also leave blank space (when solutions are not being printed) by including an optional argument with the `solution` environment; see section 5.9.3.

5.7.2   Printing lined space for answers

You can print blank lines with the command

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

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

```
\fillwithlines{\fill}
\newpage
```

If you want to equally distribute the space for answers among the questions on the page, then just put `\fillwithlines{\fill}` after each question on the page 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 5.9.3.

5.7.3   Short answer questions

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

<p align="center"><code>\answerline</code></p>

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

<p align="center"><code>\setlength\answerskip{2ex}</code>
<code>\setlength\answerlinelength{1in}</code></p>

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?

<div align="right">2. _____</div>

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

<div align="right">3. _____</div>

and if you type

<p align="center">Page 31</p>

```
\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) ——————

5.8   Multiple choice questions

There are two environments for listing the possible answers to a multiple choice question:

- The `choices` environment creates a list with the choices as the items in the list.

- The `oneparchoices` environment lists all of the choices in a single paragraph (that is a continuation of the paragraph preceding the environment unless you leave a blank line before beginning the environment).

Both of these environments use upper case letters (i.e., "A", "B", "C", ...) to label the choices; to change this, see section 5.10.

5.8.1 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

5.8.2 The `oneparchoices` environment

If instead of the `choices` environment in the example of section 5.8.1 you use a `oneparchoices` environment, 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

5.9   Including solutions

There are two environments for printing solutions to the problems:

<div align="center">

The   `solution`   environment, and
the   `solutionorlines`   environment.

</div>

If you use these environments without any optional arguments, then they are identical: They either print the solution or nothing at all. Whether or not solutions are printed is controlled by the two commands

<div align="center">

`\printanswers`
`\noprintanswers`

</div>

Using these commands, 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 documentclass, used as in

<div align="center">

`\documentclass[answers]{exam}`

</div>

that is equivalent to giving the command `\printanswers` at the beginning of the document.

Both of these environments can take an optional argument, which is an amount of space to be inserted when solutions are not being printed. If this optional argument is used and solutions are not being printed, then:

- The `solution` enviroment inserts that amount of blank space, and

- the `solutionorlines` environment inserts that amound of space with ruled lines, as if you had given a `\fillwithlines` command (see section 5.7.2).

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 5.9.1).

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 documentclass 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."

The result would be exactly the same if the above `solution` environment were replaced by a `solutionorlines` 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` or `solutionorlines` environment in the argument of a `\fullwidth` or `\uplevel` command. For example, if you type

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


\fullwidth{\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 documentclass 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."

For both of these environments, if solutions are not being printed then the contents of the environment are ignored. If, however, you use the optional argument to the `solution` environment (see section 5.9.3), then the requested amount of blank space will be inserted when the solution isn't printed, and if you use the optional argument to the `solutionorlines` environment, then the requested amount of lined space will be inserted when solutions are not being printed. For all of this, see section 5.9.3.

5.9.1   Printing the solution on a shaded background

If you load the `color` package with the command

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

in the preamble of your document, then you can give the command

$$\texttt{\textbackslash shadedsolutions}$$

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 `ShadeColor`. For example, if you give the command

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

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

$$\texttt{\textbackslash framedsolutions}$$

which returns you to the default situation.

5.9.2 Customizing the heading of the solution

The word "**Solution:**" that you see at the beginning of the solutions printed by the `solution` and `solutionorlines` environment cans 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."

The appearance of the `solution` and `solutionorlines` environments can actually be totally customized, if you're up to defining a LaTeX environment. The appearance of the solution typed into either a `solution` or `solutionorlines` environment 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 `solutionorlines` 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`.

5.9.3 Leaving blank space for the answers when solutions aren't printed

Both the `solution` and `solutionorlines` environments take an optional argument:

- In a `solution` environment this is an amount of blank space to be left when the solutions are not being printed, and

- in a `solutionorlines` environment this is an amount of lined space to be left when the 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 when solutions are not being printed, and 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 a `\fillwithlines` command; see section 5.7.2) when solutions are not being printed.

5.10   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 documentclass 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 counters question, partno, subpart, subsubpart, and choice. (The \greeknum command is defined by the exam documentclass, 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.

6 Grading tables

The exam documentclass can print a "grading table", indexed either by question number or by page numer. That is, you can print

- a table listing the question numbers 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 give the command \addpoints (see section 5.3), 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

$$\gradetable,$$

and it takes two optional arguments:

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

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

Thus,

- \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 \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 use the `\pointsofquestion` command (see section 6.2) or the `\pointsonpage` command (see section 6.3) to create a custom `tabular` environment that has more rows (or columns) than the tables produced by the `gradingtable` command.

6.1   Customizing the table

There are three ways in which you can customize the default appearance of the grading tables:

- You can change the words (and the fonts) that appear in the table.

- You can change the width of the cells that are left blank for you to write in the scores.

- You can change the value of `\baselinestretch` used for the table.

For vertical grading tables:

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 grading tables:

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 both vertical and horizontal grading tables:

`\cellwidth{length}`	changes the width of the blank cells to `length`
`\gradetablestretch{number}`	uses `number` as the `\baselinestretch`

If you don't use any of these commands then you get the default values, which are defined by the commands

`\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:}`	

For example, if you type

```
\begin{center}
  \hqword{Aufgabe Nr.:}
  \hpword{Punktzahl:}
  \htword{\textbf{Summe}}
  \hsword{Davon erreicht:}
  \cellwidth{2.2em}
  \gradetable[h]
\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:									

6.2 `pointsofquestion`

If you give the command `\addpoints` (see section 5.3), then you can use the

<p align="center"><code>\pointsofquestion</code></p>

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` command (see section 6), and it can be used to create a grading table using LaTeX's `tabular` environment when the tables produced using the `\gradetable` command 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 5.2.10).

6.3 `pointsonpage`

If you give the command `\addpoints` (see section 5.3), 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, e.g., inside of a `tabular` environment to print a custom grading table (if the grading tables that can be printed using the `\gradetable` command (see section refsec:Gradetable) are somehow unsuitable). 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: \hbox to 1in{\hrulefill}
               out of a possible \pointsonpage{\thepage} points}
```

(see section 8.3.1) will produce the footer

<div align="center">Points earned: _____ out of a possible 20 points</div>

on all pages after the first. (For another example, see section 8.10.7)

Caution: The command `\pointsonpage{\thepage}` will only work reliably in headers and footers, since `\thepage` will only work reliably in headers and footers.

7 Changing the page margins

The exam documentclass 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 documentclass option (`a4paper`, `a5paper`, `b5paper`, `letterpaper`, `legalpaper`, `executivepaper`, or

`landscape`). If you want to change the size of these margins, commands are provided to 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

$$\text{\texttt{\textbackslash extrawidth\{-1in\}}}$$

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

$$\text{\texttt{\textbackslash extrawidth\{.5in\}}}$$

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 8.4.

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 header and text constant). Thus, to increase the top margin by three quarters of an inch, you would give the command

$$\text{\texttt{\textbackslash extraheadheight\{.75in\}}}$$

To decrease the top margin by one half inch, you would give the command

$$\text{\texttt{\textbackslash extraheadheight\{-.5in\}}}$$

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 8.4.

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 footer and 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

```
\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 8.4.

8   Headers and footers

The following sections explain all of the technicalities 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 this section and instead look at the examples in sections 8.10.1 through 8.10.8 (on pages 57 through 64). You can then refer back to the technical sections for the full story on whatever isn't clear from the examples. All of the commands described in this section should be given 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 9), 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 cover pages that are analogous to the commands described in this section; for that, see section 9.1.

8.1   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 8.2 through 8.5, 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 after the \documentclass command and before the \begin{document} command.

To have both a header and a footer, give the command

```
\pagestyle{headandfoot}
```

If you want every page to have a header but no footer, give the command

```
\pagestyle{head}
```

To give every page a foot but no head, give the command

```
\pagestyle{foot}
```

Finally, to omit both the header and the footer from the page, give the command

```
\pagestyle{empty}
```

As is true in all LaTeX document classes, you can change the page style used on a single page by giving the command

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`.

8.2   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 8.2.1). The second uses the commands `\lhead`, `\chead`, and `\rhead`, each of which takes an optional argument to specify a different header for the first page (see section 8.2.2). All of these commands should be given after the `\documentclass` command and before the `\begin{document}` command.

8.2.1   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 have different header on the first page from the header 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{\bf\large Math 115\\Professor Hilbert}%
       {}%
       {\bf\large First Exam\\July 4, 1776}
```

8.2.2 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

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

```
\pagestyle{headandfoot}
\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{\bf\large Math 115\\Professor Hilbert}
\chead{}
\rhead{\bf\large First Exam\\July 4, 1776}
```

Leaving extra room for multiple line headers

See section 8.4 for a description of the \extraheadheight command.

8.3   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 8.2). 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 8.3.1). The second uses the commands \lfoot, \cfoot, and \rfoot, each of which takes an optional argument to specify a different footer for the first page (see section 8.3.2). All of these commands should be given after the \documentclass command and before the \begin{document} command.

8.3.1   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 8.6.)

8.3.2   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 8.6.)

Leaving extra room for multiple line footers

See section 8.4 for a description of the `\extrafootheight` command.

8.4 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 a 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: 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 after the \documentclass command but before the \begin{document} command. The \extraheadheight command can also be used to change the size of the text region (see section 7).

Footers

To leave extra room for multiple line footers, you use the command \extrafootheight. Thus, to move the footer one half inch higher up on the paper, you would give the command

\extrafootheight{.5in}

If you wanted to move the footer an eighth of an inch lower down on the paper, you would give the command

$$\texttt{\textbackslash extrafootheight\{-.125in\}}$$

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: 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

$$\texttt{\textbackslash extrafootheight[.5in]\{.25in\}}$$

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

$$\texttt{\textbackslash extrafootheight[.5in]\{\}}$$

then this will be interpreted as if it was

$$\texttt{\textbackslash extrafootheight[.5in]\{0in\}}$$

Note that the braces *must* appear.

If you give an `\extrafootheight` command, it should be after the `\documentstyle` command but before the `\begin{document}` command. The `\extrafootheight` command can also be used to change the size of the text region (see section 7).

8.5   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 the commands

```
\runningheadrule
\lhead{Math 115}
\chead{First Exam}
\rhead{July 4, 1776}
```

To have no footer on the first page, and the footer

on all pages after the first, you would give the commands

```
\runningfootrule
\lfoot{}
\cfoot[]{Page \thepage\ of \numpages}
\rfoot{}
```

8.6   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

you should give the commands

```
\lfoot{}
\cfoot{Page \thepage\ of \numpages}
\rfoot{}
```

For a description of the commands `\lfoot`, `\cfoot`, and `\rfoot`, see section 8.3.

As with all other cross referencing commands in LaTeX, you'll have to run the file through LaTeX *twice* to be sure that `\numpages` is correct.

8.7 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

<div align="center">

`\iflastpage{Text 1}{Text 2}`

</div>

expands to 'Text 1' on the last page, and to 'Text 2' on all pages before the last. Thus, to have the footer

<div align="center">

Please go on to the next page...

</div>

on all pages before the last page, and the footer

<div align="center">

End of exam

</div>

on the last page, you would give the commands

```
\lfoot{}
\cfoot{\iflastpage{End of exam}{Please go on to the next page\ldots}}
\rfoot{}
```

For a description of the commands `\lfoot`, `\cfoot`, and `\rfoot`, see section 8.3.

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.

8.8 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 `\oddeven` command takes two arguments. If the current page number is odd it expands to the first argument; otherwise, it expands to the second argument.

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 would use the commands

```
\rhead{\oddeven{\thepage}{}}
\lhead{\oddeven{}{\thepage}}
\chead{}
```

If you wanted the footer of the even numbered pages to be empty and the footer of the odd numbered pages to contain the 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 would use the commands

```
\lfoot{}
\rfoot{}
\cfoot{\oddeven{\iflastpage{}{Please continue\dots}}{}}
```

(see section 8.7 for an explanation of `\iflastpage`).

Although the `\oddeven` command can be used anywhere in the document (i.e., not just in headers and footers), it is reliable only in headers and footers. This is because LaTeX generally processes more text than can fit on the current page before it outputs a page. When the `\oddeven` command is encountered it will act as though it will appear on the current page whether it appears on that page or on the following page.

8.9   Questions that span multiple pages

The exam document class provides the commands `\ifcontinuation`, `\ContinuedQuestion`, `\ifincomplete` and `\IncompleteQuestion` to enable headers and footers that announce whether this page is continuing a question begun on an earlier page (and, if so, the number of that question) and whether the question at the bottom of this page continues onto the next page (and, if so, the number of that question).

These commands are only guaranteed to work 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 the pagebreak and ships out the page. They also assume that there is only one `questions` environment in the entire exam.

There is also a command `\nomorequestions` to mark the point at which the last question ends, which 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.

In more detail:

- `\ifcontinuation{Text 1}{Text 2}`
  Expands to 'Text 1' if this page begins with a part, subpart or subsubpart of a question begun on an earlier page, and expands to 'Text 2' if this page begins with a new question.

  More specifically, it expands to 'Text 2' if either

  - a question begins on this page before any part, subpart, or subsubpart begins, or
  - The current page is later than a page with the `\nomorequestions` command

  and otherwise it expands to 'Text 1'.

- `\ContinuedQuestion`
  If this page does begin with a continuation of a question begun on an earlier page, then `\ContinuedQuestion` expands to the number of that question.

  More specifically, `\ContinuedQuestion` expands to a positive number if either

  - this page doesn't contain the beginning of any question, part, subpart, or subsubpart, or
  - this page has a part, subpart, or subsubpart that appears before any question appears,

in which case \ContinuedQuestion expands to the number of the last question begun before this page.

- \ifincomplete{Text 1}{Text 2}
  Expands to Text 1 if we have not yet encountered a \nomorequestions command and if the last question begun on or before this page has a part, subpart, or subsubpart that begins on a later page. Otherwise, it expands to Text 2.

- \IncompleteQuestion
  If the last question begun on or before this page has a part, subpart, or subsubpart that begins on a later page, then this expands to the number of that question.

- \nomorequestions
  No page following the page on which this command was given will be considered to continue a question from an earlier page. Thus, if you give this command after the last question is complete, then you can include extra material (e.g., tables for use on the exam) without having those pages labelled as continuing the last question on the exam.

Thus, to have the header

<div align="center">

First Exam   Page 4

</div>

on all pages that begin a new question and the header

Question 6 continues...   First Exam   Page 4

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 8.2.2 for an explanation of \lhead, \chead and \rhead.)

To have the footer

<div align="center">

Question 3 continues...

</div>

on all pages that end with a question that will be continued onto the next page, the footer

---

<div align="center">

End of Exam

</div>

on the last page, and the footer

<div align="center">

Exam continues...

</div>

on all other pages, you would give the commands

```
\footrule
\lfoot{}
\newcommand\continues{\ifincomplete{\incompletemessage}{Exam continues\ldots}}
\newcommand\incompletemessage{Question \IncompleteQuestion\ continues\ldots}
\cfoot{\iflastpage{End of Exam}{\continues}}
\rfoot{}
```

(See section 8.3.2 for an explanation of `\lfoot`, `\cfoot` and `\rfoot`, and section 8.7 for an explanation of `\iflastpage`).

8.10   Examples

8.10.1   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}
```

8.10.2   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}
```

8.10.3   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 foot on the first page, and the footer

<div align="center">Page 2</div>

on all pages after the first, give the commands

```
\pagestyle{headandfoot}
\firstpageheader{\large\bf Mathematics 115\\
               First Exam, July 4, 1776}%
              {}{\large\bf Name:\enspace\hbox to 2in{\hrulefill}}
\runningheader{\large\bf Mathematics 115\\
             First Exam, July 4, 1776}{}{}
\firstpagefooter{}{}{}
\runningfooter{}{Page \thepage}{}
```

Alternatively, you could give the commands

```
\pagestyle{headandfoot}
\lhead{\large\bf Mathematics 115\\ First Exam, July 4, 1776}
\chead{}
\rhead[\large\bf Name:\enspace\hbox to 2in{\hrulefill}]{}
\lfoot{}
\cfoot[]{Page \thepage}
\rfoot{}
```

8.10.4   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}}
```

8.10.5   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

<div align="center">

Page 3 of 10   Please go on to the next page. . .

</div>

on all pages *except the last* page, and the footer

<div align="center">

Page 10 of 10   End of exam.

</div>

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}{}{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}
\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}}
```

8.10.6 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}{}}
```

8.10.7 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: \hbox to .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: \hbox to .5in{\hrulefill}\\
             out of a possible \pointsonpage{\thepage} points}
```

8.10.8 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}{}}
```

9   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 coverpages, but if you put the page number into the headers and/or footers (using the commands described in section 9.1), 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

<p align="center">\begin{coverpages}</p>

and you end it with the command

<p align="center">\end{coverpages}</p>

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 9.1) 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.

9.1 Headers and footers

By default, there are no headers or footers on the cover pages. 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 8 for headers and/or footers in the main part of the document. The commands for headers and footers in coverpages 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 8.