YMEXAM, A LaTeX 2ε CLASS FOR EXAMINATION PAPERS

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1. INTRODUCTION

`ymexam.cls` is a LaTeX 2ε class file for producing examination papers in the style required for the York Mathematics department. It replaces `exam.cls` which was in use up to academic year 2005/06; the name has changed partly because this version is very slightly incompatible with the older version, and partly because most LaTeX intallations now come with an unrelated file called `exam.cls`.

The class provides:

- a front page, with the examination's title, module number, duration and rubric, set in the approved format;
- a numbered `question` environment, which does not allow questions to be broken across pages without specific instructions from the user;
- automatic handling of page footers like *turn over* and *continued on next page*;
- facilities for displaying and totalling marking schemes;
- a numbered `solution` environment.

2. INSTALLATION

The current version of `ymexam.cls`, some supporting files and the old `exam.cls` are all available on the Department's web-server: from Staff Home, go to Examinations, then LaTeX Class File for Examinations. The URL at time of writing is

`http://maths.york.ac.uk/moodle/mod/book/view.php?id=25405&chapterid=470`

You should put the class file `ymexam.cls` either in the same directory (folder) as the document you are working on, or in a global inputs directory. [1] The following places should work:

central Unix: `~/texmf/tex/latex`
supported Windows: `h:\texmf\tex\latex\`
other miktex installation: `c:\localtexmf\tex\latex\`

If you use Miktex, you'll need to register the file's existence. Click on Start, Run, type `mo`, press Return, select the Roots tab, click on the root corresponding to where you put `ymexam.cls` (e.g. `h:\texmf` or `c:\localtexmf`), click on Refresh FNDB, click on OK. If you want to use both central Unix and a Miktex installation in parallel, sharing a local tree, you can create a new root at `m:\texmf`.

Date: October 2009.

[1] If you're using the old `exam.cls`, note that there is another file called `exam.cls` which ships with current versions of LaTeX, and it is important to put the local class ahead of this in the search order.

There are various sample files available; take a look at them to see the way the system works, or use one as the basis for your own file.

3. Class Declaration

`ymexam` is a LaTeX 2_ε class file, so your document should begin

```
\documentclass{ymexam}
```

By default, this class uses 12pt type on A4 paper and produces output suitable for double-sided duplication. There is rarely any need to change this, but any option understood by the `extarticle` class, and therefore any option understood by the standard `article` class, is also understood by `ymexam`. In particular, the font sizes 14pt, 17pt and 20pt can be used to make large-font copies for students with visual impairments (sizes other than 12pt should only be used in consultation with the University Examinations Office and Disability Support). [2]

4. Packages

The `ymexam` class automatically loads the AMS packages `amsmath`, `amsfonts` and the extended verbatim environments from `verbatim`.

Any other packages required can be loaded with a `\usepackage{}` declaration, as usual.

5. Topmatter

Unlike most classes, topmatter is mandatory in the `ymexam` class. After `\begin{document}`, you must specify the paper's title, the module number, the duration of the examination, the year and you must provide a rubric. When specifying the duration, the macro `\half` is provided as a convenient way to produce $\frac{1}{2}$. For example,

```
%\resit
\codenumber{0500010}
\year{2006}
\title{Analysis I}
\duration{$1\half$ hours}

\begin{rubric}
  Answer \underline{all} parts of Question~1 and \underline{two}
  of the remaining three questions. \\
  Question~1 carries 40~marks; questions~2, 3~and~4 carry
  25~marks each. \\
  Standard calculators will be provided. \\
  The marking scheme shown on each question is indicative only.
\end{rubric}

\maketitle
```

[2] Prior to Summer 2009, `ymexam`'s base class was `article`, not `extarticle`, so the large font sizes were not available.

Note the `\maketitle` command, which actually prints the topmatter. In the `rubric` environment, indicate line breaks with `\\` where required. The rubric is printed in flush left italic type.

By default, the paper is headed 'BA, BSc and MMath Examinations.' To change this (for type IV third year courses, fourth year courses and masters courses), use some combination of the macros `\BABSc`, `\noBABSc`, `\MMath`, `\noMMath`, `\MSc`, `noMSc`, `\MRes` and `\noMRes`.[3]

If the paper is a resit paper, put `\resit` at the *beginning* of the topmatter. This automatically inserts the word 'Resit' before 'Examinations' in the heading, and prefixes the module number with the letter R. [4]

The `rubric` environment can contain most LaTeX constructs. The only exceptions are those relating to page layout: you cannot use footnotes or marginal notes and you cannot split the rubric across a page.

The other topmatter commands can contain any LaTeX macros you need, but for LaTeXnical reasons cannot contain environments. I can't imagine this being a problem, but let me know if it is.

As of October 2007, in accord with guidance from the Examinations Office, the class default is that nothing is printed on the first page except the topmatter. This can be changed (against University policy!) by using `\questionfrontpage` before the `\maketitle` command, in which case the first question goes on the front page (if it will fit without breaking; see the next section for information about page-breaks within questions).

6. QUESTIONS

Questions are entered in the `question` environment. For example,

```
\begin{question}
  Show that $1/n\to 0$ as $n\to\infty$.
\end{question}
```

You can put any LaTeX instructions you like inside the `question` environment, except those relating to page breaking. In practice, this means that you should not attempt to use `\newpage`, `\pagebreak` or `\clearpage` inside a `question`, but use the `\questionbreak` macro described below. In the default layout, paragraphs are separated by some vertical space but not indented. If you want to change this, you need to change `\qparskip` and `\qparindent`; see Section 11. Do not change `\parindent` or `\parskip`.

As you would expect from LaTeX, questions are automatically numbered. By default, the total number of questions is also presented: numbers look like "1 (of 4)". The `\noquestioncount` command gives plain numbering. As with all LaTeX cross-referencing, if the number of questions changes then LaTeX will have to be run twice before the (of n) part of the question numbers is correct.

[3] There is an extensive array of synonyms for these for compatibility with existing documents; if it worked in an earier version, it still works now.

[4] For compatibility with existing documents, you can supply the R yourself, e.g. `\codenumber{R0500010}` will work correctly.

If you want separate parts within a question, use the `enumerate` environment as usual. Parts will be numbered (a), (b), (c), ... Second-level enumerated lists (i.e. an `enumerate` environment inside another `enumerate` environment) have items numbered (i), (ii), (iii), ... If you want your first order lists to be roman and your second-order lists to be alphabetic, enter `\romanfirst`; to revert to alphabetical first, enter `\alphafirst`. [5]

Questions are never broken across pages without specific instructions. If you need to break a question (typically because it is too long to fit on a single page even on its own), you can put a `\questionbreak` command where you want the break to occur. The break occurs exactly at this point, so you should normally put it between paragraphs or between a paragraph and a displayed equation: if you put a `\questionbreak` command inside a paragraph, the last line on the page will not be justified.

If you want to force a page break between questions, as opposed to inside a question, use `\pagebreak` or `\newpage` in the usual way; for example

```
\end{question}

\pagebreak

\begin{question}
```

The reason for the separate commands is that a pagebreak inside a question prints '*Continued on next page*' and repeat the question number as 'x *Cont.*' on the next page.

7. PARTS

If the paper contains multiple parts, begin each one with the `\part` command,[6]. e.g.

```
\part{Hilbert Spaces.}
```

This prints a bold heading on the lines of **Part A. Hilbert Spaces.** Note that `\part` does not cause a pagebreak. Use one of the standard pagebreaking commands (e.g. `\clearpage`) before the `\part{}` command (but after the preceding `\end{question}`) if you want your section to start on a new page.

If you are writing just one part of the paper and want to generate the correct heading without earlier parts being present, you can use `\skippart`. For example, to put a heading **Part B. The Lebesgue Integral** at the top of the paper, begin with

```
\skippart
\part{The Lebesgue Integral}
```

The `\skippart` macro can take an optional argument: to skip two parts, use `\skippart[2]` (note square brackets; `\skippart{2}` *does not* work).

If you use `\skippart`, you probably also need to use `\skipquestion` and `\skipsolution`, which step the question and solution counters. Like `\skippart`, they default to skipping one question, but take an optional argument to skip more.

[5] Compatibility with existing documents: `\romantrue` and `\romanfalse` are synonyms for `\romanfirst` and `\alphafirst`.

[6] For compatibility with existing documents, `\nextpart` is a synonym for `\part{}`

For example, if parts A and B have three questions each and you are just writing part C, you might begin (imediately after `\begin{document}`) with

```
\skippart[2]
\skipquestion[6]
```

and between the last question and first solution

```
\skipsolution[6]
```

The `\partinquestion` command makes the part number appear within each question number, so questions might be numbered A1, A2, A3, B4, B5, etc. [7] If you use this, you probably want `\noquestioncount` as well, otherwise you'll end up with numbers like "A1 (of 5)."

8. SOLUTIONS

You can put solutions into the same document as the questions, using the `solution` environment. You can put anything you like inside a `solution` environment, including footnotes and marginal notes. Solutions are subject to LaTeX's normal page-breaking algorithm: there is no analogue of `\questionbreak`.

One extra environment is provided for convenience in typing solutions. The `remarks` environment, intended for remarks to the checker or external examiner, typesets its contents as a separate paragraph, in italics, with a bold heading **Remarks**. For example,

```
\begin{remarks}
  This question lifted verbatim from last year's paper.
\end{remarks}
```

produces

Remarks. *This question lifted verbatim from last year's paper.*

You can suppress the printing of remarks by entering `\noremarks` and reinstate it with `\showremarks`.

To entirely suppress the printing of solutions (when you print the final copy for duplication, for example) put the command `\nosolutions` in your preamble.

Note that you *cannot* intersperse questions and solutions: you must have all of the questions in order, followed by all of the solutions in order.

9. MARKS AND TOTALS

In both the question and solution environments, you can use `\marks{n}` to indicate how many marks are assigned to part of the question. The number is printed flush right, and can be used either in text or inside displayed mathematics. In displayed mathematics (including the $\mathcal{AMS}$LaTeX primary environments such as `align`, `gather` and `multline`) the number of

[7] The `\numberwithinpart` command causes the question number to reset to 1 at the beginning of each part, so the numbering sequence might be A1, A2, A3, B1, B2, B3, etc. This is best avoided: it only makes sense if `\partinquestion` is switched on, it's incompatible with `\questioncount` and I think it's against the University layout rules.

marks appears where the equation number would normally go, so don't use it in combination with equation numbers! For example,

```
$$\sum_{n=1}^\infty\frac{1}{n^2}=\frac{\pi^2}{6}\marks{5}$$
```

might produce (depending on the current style, see below)

$$\sum_{n=1}^{\infty}\frac{1}{n^2}=\frac{\pi^2}{6}$$ (5 Marks)

If you don't want the number of marks to be right-aligned, use `\marks*{}` instead; the format is the same, but the resulting box is set inline. There are some circumstances in which `\marks{}` returns an error, and `\marks*{}` has to be used[8]; in particular, `\marks{}` does not work in $\mathcal{AMS}$ subsidiary mathematics environments such as `aligned`, `gathered` and `split`.[9]

The command `\noquestionwordmarks` suppresses the word "Marks" in the output with question environments (this is the default), and the command `\questionwordmarks` restores it; `\solutionwordmarks` (the default) and `\nosolutionwordmarks` work in the same way for solutions.

The format can be changed with a command of the form `\questionmarkstyle{style}` or `\solutionmarkstyle{style}` in the preamble[10]: Predefied styles are `box`, `oval`, `bracket` and `boldbracket`, which produce results like 5 marks, (5 Marks) (default for solutions), [5 Marks] and **[5 Marks]** (default for questions) respectively. If you want to define a new style `x`, define a macro `\markx` which takes one argument and supplies the framing or whatever; e.g. the definition of `\markbracket` is simply

```
\newcommand{\markbracket}[1]{\mbox{[#1]}}
```

To typeset marks which do not contribute to the question total (e.g. in presenting marks for an either/or question, or marking schemes for alternative solution strategies), use `\suspendtotal` and `\resumetotal`: any `\marks` command between these display in the usual way, but do not change the question total. Note that `\begin{question}` and `\begin{solution}` implicitly execute `\resumetotal`.

At the end of each question or solution, the total number of marks can be printed. For questions, the default is not to print totals; you can change this with `\questiontotals` in the preamble. For solutions, the defaults is to print the total; you can suppress it with `\nosolutiontotals`. `\noquestiontotals` and `\solutiontotals` work as expected, but are unnecessary unless you want totals on some, but not all, questions or solutions.

For example, to reproduce the default state where marks appear in the form **[5]** in the questions, without totals, and in the form (5 Marks) in the solutions, with totals, you would enter in the preamble:

[8] In versions of `exam.cls` prior to 4/4/2004, `\marks{}` "worked" in these contexts, in the sense that it did not produce an error but failed to align properly. Documents written for these classes might therefore need to be updated to work with the new class.

[9] This is because, within these environments, TEX is in text-style mathematics mode, not display-style.

[10] For even finer control, you can use `\markstyle`, `\wordmarks` and `\nowordmarks` which override the current settings; this can be used to give different layouts in different questions, or even different parts of the same question, which is almost certainly not a good idea!

```
\questionmarkstyle{boldbracket}
\noquestionwordmarks
\noquestiontotals
\solutionmarkstyle{oval}
\solutionwordmarks
\solutiontotals
```

10. Headers and Footers

The page headers all contain the module number, right-aligned. Headers of solution pages also contain the word "SOLUTIONS", centred.

The page footers all contain the page number, centred. On solution pages, this is a simple arabic number; but the page number on question pages is printed in the form "Page x (of y)". The final page number, of course, is the last question page, not the last page in the document. This formatting feature can be switched off with `\nopagecount` (but don't do this for new papers). The last page is recorded with a LaTeX `\label` called `lastqpage` so, the first time LaTeX is run, there will be an "undefined label" error associated with this name. As with all LaTeX cross-referencing, if the number of pages changes then LaTeX will have to be run twice before the footers are correct. [11]

When a question is broken across pages by the `\questionbreak` command, the footer of the page before the break contains "continued on next page" and the header of the page after the break contains "continued from previous page".

The last footer of the last question page contains "End of examination."

11. Adjustable Lengths

There are five lengths you can change. Recall that (approximately) 1ex is the height of a lowercase 'x' in the current font and 1em is the width of a capital 'M.'

(1) `\qksip` is the vertical space left between questions (default 4ex).
(2) `\qindent` is the distance from the left margin of the paper and the left margin of the question (default 5em).
(3) `\qlabelsep` is the space between the label and the item in secondary list environments (e.g. `enumerate`, `itemize` and `description`). Default is currently 1em, which is quite wide; I might reduce this at some point.
(4) `\qparindent` is the extra paragraph indentation used inside a question (default 0pt).
(5) `\qparskip` is the space between paragraphs inside a question (default 1ex).

You can change these using `\setlength` in the preamble of your document (that is, between the `\documentclass` declaration and the `\begin{document}`). For example, the default values are generated by

```
\setlength{\qindent}{5em}
\setlength{\qlabelsep}{1em}
\setlength{\qskip}{4ex}
```

[11] In versions earlier than Summer 2009, all page numbers were simple arabic numbers.

```
\setlength{\qparindent}{0pt}
\setlength{\qparskip}{1ex}
```

Note that the usual approach of changing `\parindent` and `\parskip` will not affect the layout of paragraphs within a question, but will wreak havoc on the layout of questions within the paper. Use `\qparindent` and `\qparskip` instead.

12. Bugs, Problems, Limitations

This class does some fairly complicated stuff with page headers and footers and with TEX penalties. Although I think it all works OK, there might well be bugs lurking which I haven't spotted. Some limitations have been pointed out above; let me know if they cause any major problems and I'll try to fix them.

I haven't really attempted to make the class entirely bomb-proof: there are some things which you can do which will upset it in a big way, such as making a `\pagestyle` or `\thispagestyle` declaration, using any sectioning commands other than `\part`, using a third level of enumeration, using `\pagebreak`, etc. Be gentle!

Changes made October 2009

Added `\suspendtotal` and `\resumtotal`.

Changes made May 2009

(1) Changed base class to `extarticle` to gain easy access to large font sizes.
(2) Changed page number format to "Page x (of y)". Can be switched off (against University policy) with `\nopagetotal`.
(3) Now imports `fullpage` package to reduce margin widths.

Changes made October 2007

Added default pagebreak after `\maketitle`. Can be switched off (against University policy) with `\questionfrontpage`.

Changes made October/November 2006

(1) Minor bugfix: literal `\markstyle` echoed into text under some circumstances.
(2) Minor bugfix to `\marks`: literal `#1` echoed into text under some circumstances.

Changes made 23/8/2006

(1) Added missing `\global` on several definitions and conditional switches.
(2) Added and documented `\marks*`

CHANGES MADE 14/8/2006

(1) Renamed to `ymexam.cls` to stop confusion with `exam.cls` in standard distributions.
(2) Added automatic addition of R to code number if not present on resit papers.
(3) Added `\questionmarkstyle`, `\solutionmarkstyle`, the lower level `\markstyle`, several conditionals to control mark display and generally reworked mark display code.
(4) Added LaTeX-style aliases for all the plain TeX conditionals.
(5) Separated `\nomarks` and `\noremarks`.
(6) Added
End of examination." as final-page footer.
(7) Wrote up various undocumented features.

CHANGES MADE AT SOME POINT IN 2005

(1) Changed question numbering to "1 (of 4)" format, added option to number questions within sections.
(2) Fixed eTeX incompatibility (`\marks` is an eTeX primitive).

CHANGES MADE 27/4/2004

Rewrote the page header and footer mechanism using `\mark` to make the header and footer changes associated with `\questionbreak` more robust.

CHANGES MADE 4/4/2004

Rewrote `\marks{}` so it works inside display math.

CHANGES MADE 1/3/2002

(1) Added `\msctrue`, `\mrestrue` and friends, completely rewriting the title generator in the process.
(2) Added `\part` macro for giving titles to parts.

CHANGES MADE 25/1/2000

(1) Added `\resittrue` and `\resitfalse` to control use of 'Examinations' v. 'Resit Examinations' in header.
(2) Added `\MMathfalse`, `\BABScfalse`, `\MMathtrue` and `\BABSctrue` as synonyms of their uncapitalised forms.

CHANGES MADE 10/12/98

Commands `\babscfalse`and `\babsctrue` added to go with `\mmathfalse` and `\mmathtrue`.

CHANGES MADE 1/7/97

Minor enhancements (I hope):

(1) `\nomarks` command suppresses the printing of marks and totals, and also of the contents of `remarks` environments. This is intended for printing papers with solutions for the library, without revealing the marking scheme or any remarks to the external examiner.
(2) `\nosolutions` suppresses the contents of the `solution` environments. This is intended for printing the final copy for duplication.

Note that these commands are irreversible: you can't switch the marking scheme back on again having switched it off with `\nomarks`. Note also that `\marksfalse` still works the way it used to, suppressing marks and totals but not `remarks` environments, but that `\nomarks` is now the preferred way to do this. I might withdraw `\marksfalse` at some point, as this would simplify the code.

CHANGES MADE 3/3/97

(1) Page-breaking algorithm completely recoded so `\questionbreak` can be used anywhere you like, even within an item of a secondary or tertiary list.
(2) `\marks` now works, and also keeps track of totals for each question.
(3) There is now some space (`\qlabelsep`) between labels and items in labelled lists inside the `solution` environment. This also controls such spacing in the `question` environment, which was previously left at the `article.cls` default, so you might notice a slight difference in questions.
(4) The `rubric` environment is now much more flexible. You can put almost anything you like inside it, including labelled lists and aligned mathematics.