LaTeX Workshop
The exam class

Student chapters of AWM and SIAM

University of Utah

August 28th, 2019

The exam class

```
\documentclass[options...]{exam}

\begin{document}
...
\end{document}
```

Questions and Solutions

1. Decide whether the geometric series $\sum_{k=0}^{\infty} 3^{2k+1}2^{-k}$ is convergent or divergent. If it is convergent, find its sum.

2. Find the Taylor series of $f(x) = e^{2x}$ about $a = 0$. Use Sigma notation to express it.

1. Decide whether the geometric series $\sum_{k=0}^{\infty} 3^{2k+1}2^{-k}$ is convergent or divergent. If it is convergent, find its sum.

Solution:

$$\sum_{k=0}^{\infty} 3^{2k+1}2^{-k} = \sum_{k=0}^{\infty} 3\left(\frac{9}{2}\right)^k$$

So the common ratio $r = \frac{9}{2} > 1$ and the series is divergent.

2. Find the Taylor series of $f(x) = e^{2x}$ about $a = 0$. Use Sigma notation to express it.

Solution:

$$f'(x) = 2e^{2x} \qquad f''(x) = 2^2e^{2x} \qquad f^{(k)}(x) = 2^ke^{2x}$$

This gives $f^{(k)}(0) = 2^k$ and the Taylor series is

$$T(x) = \sum_{k=0}^{\infty} \frac{2^k}{k!}x^k.$$

Questions and Solutions

```
\begin{questions}

\question First question...
\begin{solution}[4cm]
Solution...
\end{solution}

\question Next question...
\begin{solution}[\fill]
Solution...
\end{solution}

\end{questions}
```

Questions and Solutions

```
\begin{questions}

\question First question...
\begin{solution}[4cm]
Solution...
\end{solution}

\question Next question...
\begin{solution}[\fill]
Solution...
\end{solution}

\end{questions}
```

These are only shown when the option `answers` is selected:

`\documentclass[answers]{exam}`

Questions and Solutions

```
\begin{questions}

\question First question...
\begin{solution}[4cm]
Solution...
\end{solution}

\question Next question...
\begin{solution}[\fill]
Solution...
\end{solution}

\end{questions}
```

Without the option `answers` this is the height of the empty space, `\fill` makes it as high as possible

Points and point table

Question:	1	2	Total
Points:	8	12	20
Score:			

1. (8 points) Decide whether the geometric series $\sum_{k=0}^{\infty} 3^{2k+1}2^{-k}$ is convergent or divergent.

   If it is convergent, find its sum.

Points and point table

```
\documentclass[addpoints]{exam}

\begin{documents}

\gradetable[h][questions]

\begin{questions}
\question[8] First question ...
...
\end{questions}

\end{document}
```

Points and point table

```
\documentclass[addpoints]{exam}

\begin{documents}

\gradetable[h][questions]

\begin{questions}
\question[8] First question ...
...
\end{questions}

\end{document}
```

Orientation of the table, alternative: v

Points this question is worth.

More about questions

Question:	Taylor series	Geometric series	Total
Points:	12	8	20
Score:			

1. (12 points) **Taylor series** Given $f(x) = e^{2x}$.

   (a) Find the first five derivatives at $a = 0$.

   (b) Find the Taylor series of $f(x)$ about $a = 0$.

More about questions

```
\begin{questions}
\titledquestion{Title}[12] {\bf\thequestiontitle}
First question ...
\begin{parts}
\part First part...
...
\part Second part...
...
\end{parts}
\end{questions}

\end{document}
```

More about questions

```
\begin{questions}
\titledquestion{Title}[12] {\bf\thequestiontitle}
First question ...
\begin{parts}
\part First part...
...
\part Second part...
...
\end{parts}
\end{questions}

\end{document}
```

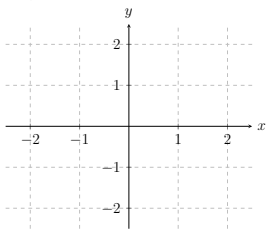
There is also `subparts`.

Graphs

1. Consider the function $f(x) = x^3 - x + 1$ on $[-1, 1]$.
   (a) Find the average value.

   (b) Find all c, such that $f(c) = f_{ave}$

   (c) Sketch the graph of f and a rectangle with base $[-1, 1]$, whose area is the same as the area under graph of f.



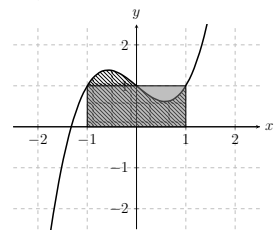
1. Consider the function $f(x) = x^3 - x + 1$ on $[-1, 1]$.
   (a) Find the average value.

   Solution:
   $$f_{ave} = \frac{1}{2}\int_{-1}^{1} f(x)\, dx = 1$$

   (b) Find all c, such that $f(c) = f_{ave}$

   Solution:
   $$1 = f_{ave} = f(c) = c^3 - c + 1\,, \implies c^3 - c = 0\,, \implies c = -1, 0, 1$$

   (c) Sketch the graph of f and a rectangle with base $[-1, 1]$, whose area is the same as the area under graph of f.



   Solution: The area under the graph is
   $$A = \int_{-1}^{1} f(x)dx = 2f_{ave}\,.$$
   Since the interval $[-1, 1]$ has length 2, a rectangle with height $f_{ave} = 1$ with base $[-1, 1]$ has the same area as the area under the graph.

Graphs

```
...
\usepackage{pgfplots}
...
\begin{tikzpicture}
\begin{axis}[
xmin=-2.5,xmax=2.5,ymin=-2.5,ymax=2.5,
xtick={-2,-1,...,2},ytick={-2,-1,...,2},
...
]
\ifprintanswers
\addplot {x^3-x+1};
...
\fi
\end{axis}
\end{tikzpicture}
```

Graphs

```
...
\usepackage{pgfplots}
...
\begin{tikzpicture}
\begin{axis}[
xmin=-2.5,xmax=2.5,ymin=-2.5,ymax=2.5,
xtick={-2,-1,...,2},ytick={-2,-1,...,2},
...
]
\ifprintanswers
\addplot {x^3-x+1};
...
\fi
\end{axis}
\end{tikzpicture}
```

Everything between `\ifprintanswers` and `\fi` is only shown when the option `answers` is selected.

Coverpages

MATH 1321-001, Fall 2019

Midterm #1

Instructions:

1. Check that you have all pages.
2. Write your name on the front page.
3. You have 50 minutes for this exam.
4. Write down all your work for full credit.
5. You are not allowed to use calculators or phones or notes.

Name: _____

Question	Points	Score
1	10	
2	10	
3	15	
4	5	
5	20	
Total:	60	

MATH 1321-001, Fall 2019

Midterm #1

Instructions:

1. Check that you have all pages.
2. Write your name on the front page.
3. You have 50 minutes for this exam.
4. Write down all your work for full credit.
5. You are not allowed to use calculators or phones or notes.

Name: _____

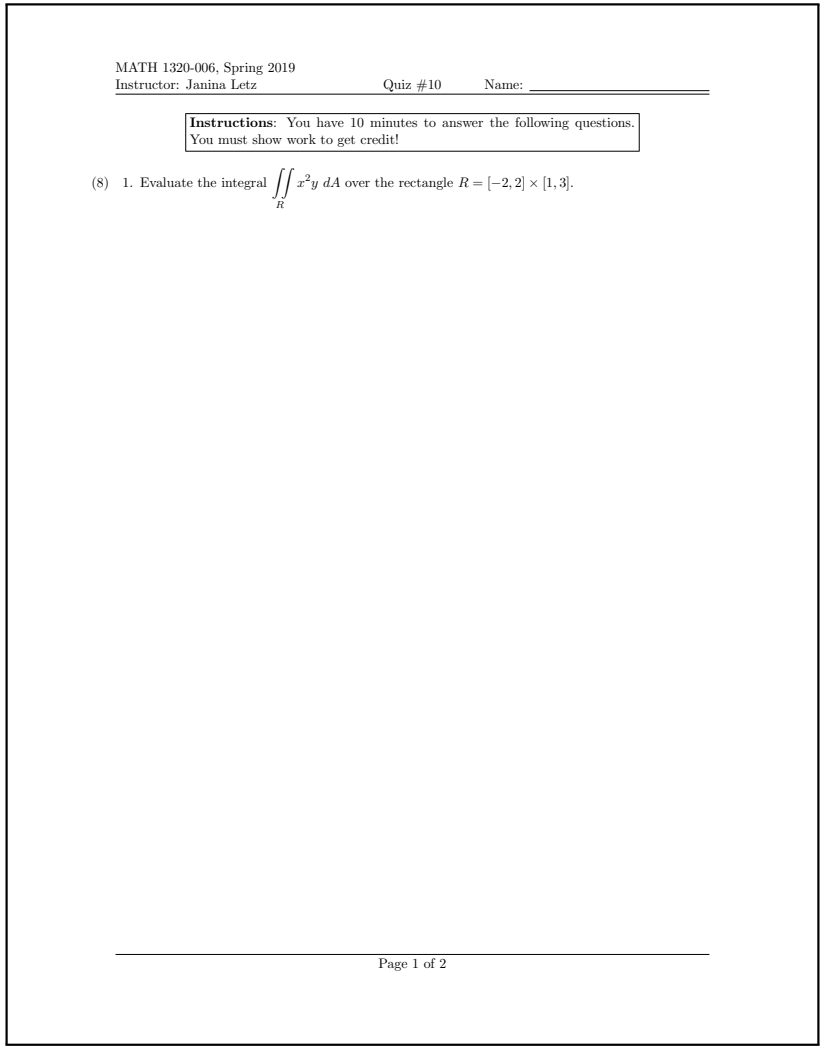
Question	Points	Score
1	10	
2	10	
3	15	
4	5	
5	20	

Question	Points	Score
6	10	
7	15	
8	5	
9	20	
Total:	110	

Coverpages

```
\begin{coverpages}
\begin{center}
\ \vspace{1cm}
{\Huge{MATH 1321-001, Fall 2019}}
\vspace{1cm}
{\Large{Midterm \#1}}
\vspace{2cm}
\fbox{\fbox{\parbox{0.75\textwidth}{\textbf{Instructions}:  ...  }}}
\vspace{2cm}
\noindent\textbf{Name:} \underline{\hspace{0.5\textwidth}}
\vspace{2cm}
\multicolumngradetable{2}[questions]
\end{center}
\end{coverpages}
```

Header and Footer



MATH 1320-006, Spring 2019
Instructor: Janina Letz Quiz #10 Name: _____

Instructions: You have 10 minutes to answer the following questions.
You must show work to get credit!

(8) 1. Evaluate the integral $\iint_R x^2 y \, dA$ over the rectangle $R = [-2, 2] \times [1, 3]$.

Header and Footer

```
\pagestyle{headandfoot}


\headrule
\header{MATH 1320-006, Spring 2019\\Instructor:
Janina Letz}{Quiz \#10}{\oddeven{Name:
\underline{\hspace{5cm}}}{}}

\footrule
\footer{}{Page {\thepage} of \numpages}{}
```

Header and Footer

```
\pagestyle{headandfoot}

\headrule
\header{MATH 1320-006, Spring 2019\\Instructor:
Janina Letz}{Quiz \#10}{\oddeven{Name:
\underline{\hspace{5cm}}}{}}

\footrule
\footer{}{Page {\thepage} of \numpages}{}
```

only header: `head`
only footer: `foot`

Header and Footer

```
\pagestyle{headandfoot}


\headrule
\header{MATH 1320-006, Spring 2019\\Instructor:
Janina Letz}{Quiz \#10}{\oddeven{Name:
\underline{\hspace{5cm}}}{}}

\footrule
\footer{}{Page {\thepage} of \numpages}{}
```

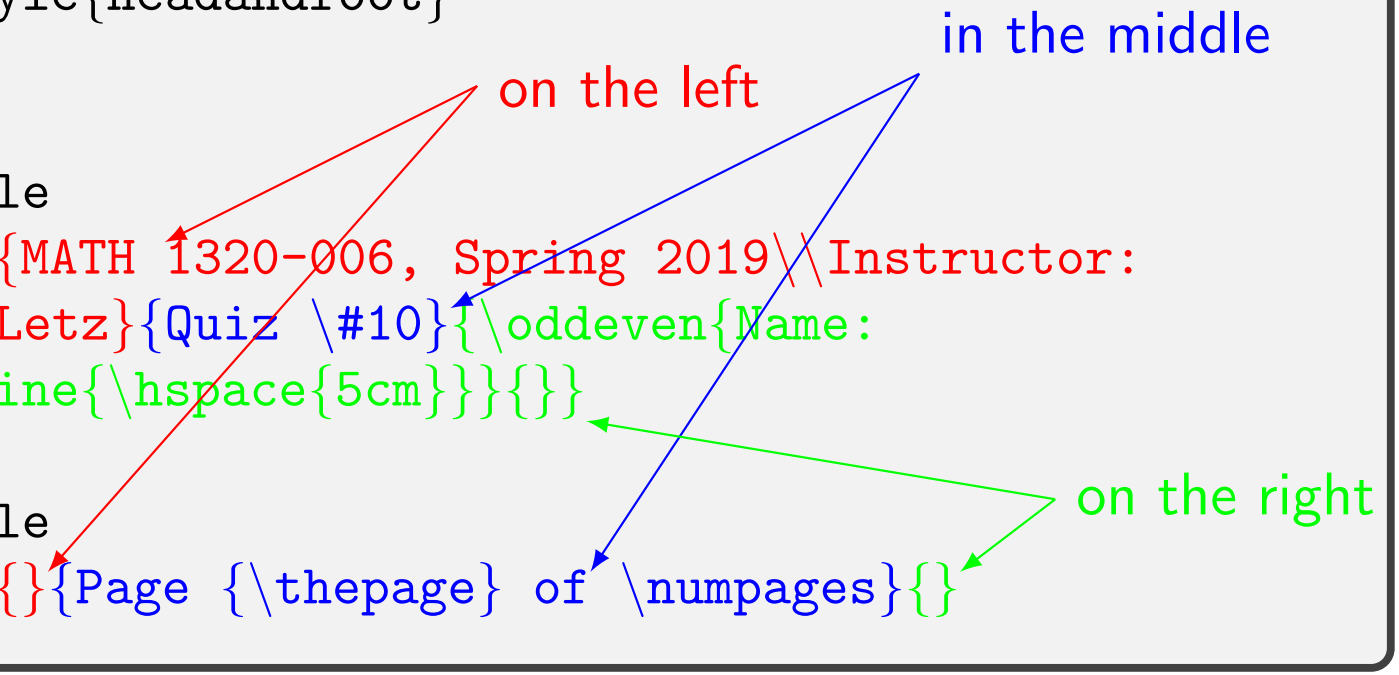
Line below the header resp. above the footer.

Header and Footer

```
\pagestyle{headandfoot}


\headrule
\header{MATH 1320-006, Spring 2019\\Instructor:
Janina Letz}{Quiz \#10}{\oddeven{Name:
\underline{\hspace{5cm}}}{}}

\footrule
\footer{}{Page {\thepage} of \numpages}{}
```



Header and Footer

```
\pagestyle{headandfoot}


\headrule
\header{MATH 1320-006, Spring 2019\\Instructor:
Janina Letz}{Quiz \#10}{\oddeven{Name:
\underline{\hspace{5cm}}}{}}

\footrule
\footer{}{Page {\thepage} of \numpages}{}
```

Shown on odd pages.

Shown on even pages.

Units: siunitx

$$\alpha = 90^\circ$$

$$m = 10\,\mathrm{kg}$$

$$c = 3 \times 10^8\,\mathrm{m\,s^{-2}}$$

Give the answer in µm.

```
\usepackage{siunitx}
...
\alpha = \ang{90}
...
m = \SI{10}{\kg}
...
c =
\SI{3e8}{\m\per\s\squared}
...
\si{\micro\m}
```

Math comments

- For math inside text use `\displaystyle`: That gives $\lim\limits_{n\to\infty} a_n$ instead of $\lim_{n\to\infty} a_n$.
- Make sure the size of the paranthesis matches the size of what is inside:

$$\left(\frac{3^n+1}{n^2}\right)^3 \quad \text{instead of} \quad (\frac{3^n+1}{n^2})^3 .$$

```
\left(\frac{3^n + 1}{n^2}\right)^3
```

Math comments: cases environment

$$b_j = \begin{cases} \int_C f_j(x)\ dx & j \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

```
b_j = \begin{cases} \int_C f_j(x) ~dx & j \geq 0 \\0
& \text{otherwise}\end{cases}
```

$$b_j = \begin{cases} \int_C f_j(x)\ dx & j \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

```
b_j = \begin{dcases} \int_C f_j(x) ~dx & j \geq 0 \\0
& \text{otherwise}\end{dcases}
```

Math comments: Matrices

```
\begin{pmatrix}
1 & 5 \\
3 & 4
\end{pmatrix}
```

$$\begin{pmatrix} 1 & 5 \\ 3 & 4 \end{pmatrix}$$

```
\begin{bmatrix}
1 & 5 \\
3 & 4
\end{bmatrix}
```

$$\begin{bmatrix} 1 & 5 \\ 3 & 4 \end{bmatrix}$$

```
\begin{vmatrix}
1 & 5 \\
3 & 4
\end{vmatrix}
```

$$\begin{vmatrix} 1 & 5 \\ 3 & 4 \end{vmatrix}$$

Macros

Make your life easier and define macros for (long/complicated) commands you use a lot.

```
\newcommand{\uvec}[1]{\hat{#1}}
\newcommand{\ivec}{\uvec{\imath}}
\newcommand{\jvec}{\uvec{\jmath}}
\newcommand{\kvec}{\uvec{k}}
...
\vec{v} = 3 \ivec + 2 \jvec - 9 \kvec
```

$$\vec{v} = 3\hat{\imath} + 2\hat{\jmath} - 9\hat{k}$$