LaTeX Template

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One of the best ways to learn LaTeX is to look at examples. This document contains many of the things that you might be looking to do as you first begin using LaTeX. If you're looking to do something not included here, then Google search is your best friend! There are many examples available online for you to look at and adapt for your own needs.

1 Packages.

Invoking a package in the preamble of a document allows us to use some of the "fancier" features of LaTeX. In this document, we've included some of the more standard packages that are used in LaTeX documents. It should be noted that many packages are already bundled with the distribution; however it is sometimes necessary to install a package from a repository.

2 Formatting Text.

Formatting text in LaTeX is relatively simple. For instance, this is standard text. **This is bold text.** *This is italic text.* THIS IS SMALL CAPITAL TEXT. `This is typewriter text.` This is colored text.

Environments are very helpful in LaTeX; they allow for quick formatting for various situations. For instance, if we we have a quote:

> *"Mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true."*   –Bertrand Russell

Or if we have a poem:

Hyperboloids of wondrous Light
Rolling for aye through Space and Time
Harbour there Waves which somehow Might
Play out God's holy pantomime.   –Alan Turing

Or if we want something to appear exactly as we've typed it no matter what:

```
jfkldsjlfjsdfkjsdfjdwkl  ''  ?  {  %  @  #  +  =
fldksjfldjflkdjflkdjsk                        jfkldsfkldjsfdjslk  mkfldsjfkl
hello 5464654543321 35   kfjdwsfjlkdjsfkdjs
lkjdslfjsldfjdjfkld                                 It doesn't even matter that this is of:
```

2.1   Line Spacing.

Here is some text with 1.5 line spacing. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Here is some text with double spacing. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

2.2   Lists.

Numbered lists may be created as such:

1. This is item one.

2. This is item two.

3. This is item three.

Unnumbered lists may be created as such:

- Here's an item!

- Here's an item!

  - Here's a sub-item!

- Here's an item!

Here's another type of list:

Description 1 Some stuff about it...

Description 2 Some stuff about it...

Description 3 Some stuff about it...

3   Typesetting Mathematics.

We may wish to include some math within the text of our document. This can be accomplished as such: $x^3 + 2x - 4$ is a polynomial. On the other hand, we may sometimes wish to have the mathematics displayed more prominently:

$$f(x) = x^3 + 2x - 4$$

A good example that highlights how to handle fractions and square roots is the Quadratic Formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{where } a, b, c \in \mathbb{R}$$

We may also wish to write equations aligned together, as we may do when solving a simple linear equation:

$$5x + 3 = 13$$
$$5x = 10$$
$$x = 2$$

Many operators are already built into LaTeX, however there are some we may wish to add:

$$\exp[i\theta] = \cos\theta + i\sin\theta \qquad \text{best\{Math, English\}} = \text{Math}$$

Here are some symbols that should be familiar:

$$\int_a^b f(x)dx = \lim_{\max \Delta x_k \to 0} \sum_{k=1}^n f(x_k^*)\Delta x_k$$

Sometimes we need parentheses that wrap around large math objects:

$$A(t) = P\left(1 + \frac{r}{m}\right)^{mt} \qquad \left\{1, \frac{1}{2}, \frac{1}{3}, \cdots\right\}$$

Matrices might also be a good thing to know:

$$\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix} \qquad \begin{pmatrix} 2 & 3 & 5 & 7 \\ 11 & 13 & 17 & 19 \\ 23 & 29 & 31 & 37 \end{pmatrix} \qquad \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

As with piecewise functions:

$$g(x) = |x| := \begin{cases} -x & x < 0 \\ x & x \geq 0 \end{cases}$$

LaTeX is particularly handy for it's ability to reference specific equations.

$$\rho\left(\frac{\partial v}{\partial t} + v \cdot \nabla v\right) = -\nabla p + \nabla \cdot T + f \tag{1}$$

Do you recognize Equation (1)? It's the general form of the Navier-Stokes Equations which describe fluid motion!

As with standard text formatting, there are also many environments for mathematics. In fact, we've already seen some examples – although there are many more. Here's a fancy way of writing out a theorem:

Lebesgue Dominated Convergence Theorem. *Let $\{f_n\}$ be a sequence of measurable functions on E. Suppose there is a function g that is integrable over E and dominates $\{f_n\}$ on E in the sense that $|f_n| \leq g$ for all n. Then:*

$$\{f_n\} \to f \ \text{pointwise a.e. on } E \quad \Rightarrow \quad f \text{ is integrable over } E \text{ and } \lim_{n\to\infty} \int_E f_n = \int_E f.$$

Here's an easy way to create boxes for formulas, etc:

Simple Interest.

$$FV = PV(1 + rt) \quad \text{where} \quad \begin{cases} FV = \text{future value} \\ PV = \text{present value} \\ r = \text{interest rate} \\ t = \text{time} \end{cases}$$

4 Tables.

Basic text tables may be created as such:

Col 1	Col 2	Col 3
This	This	This
Column	Column	Column
Is	Is	Is
Right	Left	Centered
Aligned	Aligned	

We may also wish to create a table with a bunch of math in it:

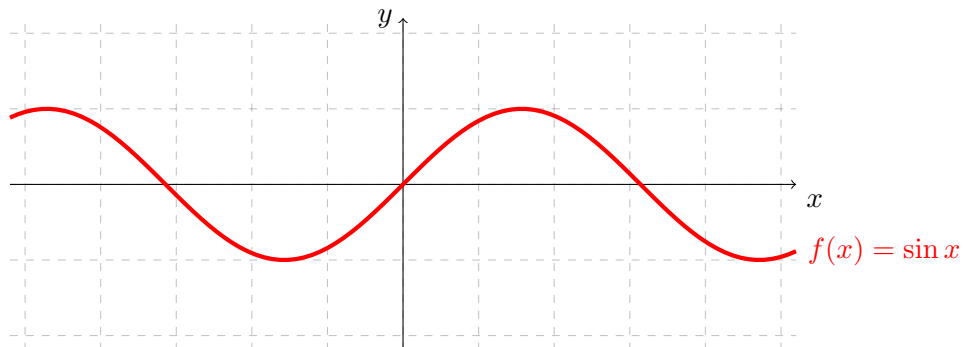| Col 1	Col 2	Col 3
α	x	$\frac{1}{2}$
β	x^2	$1/3$
γ	x^3	$\frac{1}{4}$

5   Figures.

In general, you may either import a figure that is saved outside of your LATEX file or you may generate the figure within LATEX. To include an outside figure, simply use the code:
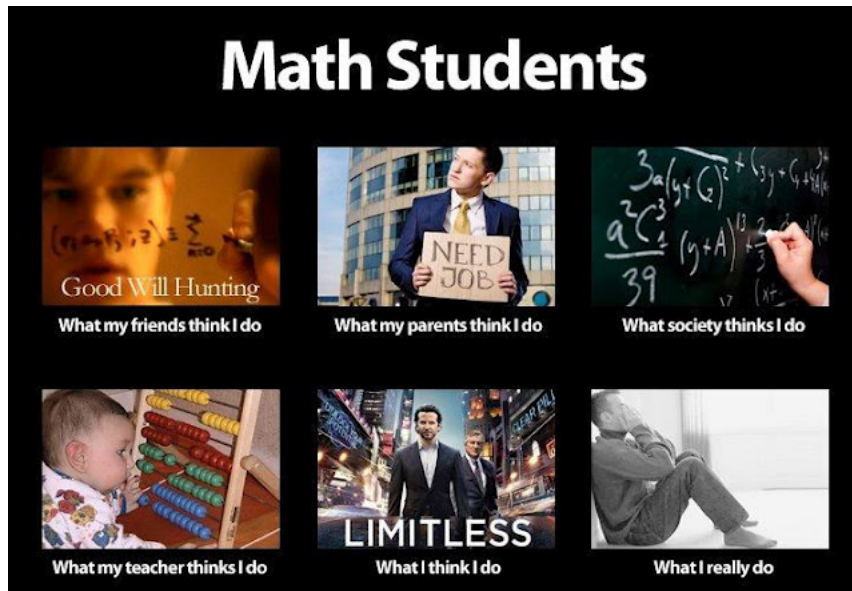
Alternatively, you may draw figures directly in LATEX. Here is the plot of a wonderful function:

And here is a graph:
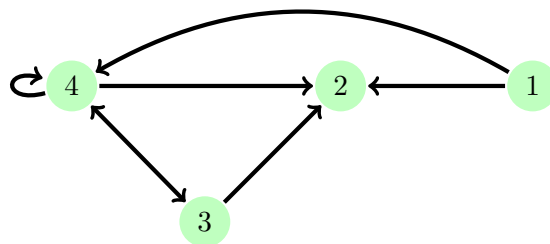
6   BIBTEX.

BIBTEX is a reference management system that can be used alongside LATEX. It is relatively simple to use; however, it does require a `.bib` file that stores all of the reference information. For in-text citations, you use [2, p. 2]. Once you have made the BIBTEX file, then it is very easy to create a reference list (in any format you may choose):

References

[1] David J Bruce, Pin-Hung Kao, Evan D Nash, Ben Perez, and Peter Vermeire. Betti tables of reducible algebraic curves. *Proc. Amer. Math. Soc.*, August 2014.

[2] Patrick Davis and Pin-Hung Kao. A practical introduction to LATEX, 2014.