LaTeX Reference for Proof Writing

For d.PotD

1 Document Boundaries

Every LaTeX file must start and end with these commands. The LaTeX editor in the testing page will have these commands preloaded.

- **Start:** `\documentclass` and `\begin{document}`
- **End:** `\end{document}`

```
\documentclass[12pt, article]{article}
\usepackage{amsmath}
\begin{document}
    Your Title, Sections, and Proofs go here.
    \section{My Proofs}
\end{document}
```

2 Document Structure and Text Formatting

Basic Formatting

- **Bold Text:** `\textbf{text}` →**text**
- **Underline Text:** `\underline{text}` →<u>text</u>
- **Section:** `\section{Title}`
- **List:** Use `\begin{enumerate}`

Proof Structure Example

When outlining steps in a proof, we often use the enumerate environment.

LaTeX source code:

```
\begin{enumerate}
\item \textbf{Assumption/Given:} State the known facts or definitions.
\item \textbf{Step 1 (Manipulation):} Apply the first logical rule or algebraic step.
\item \textbf{Step 2 (Deduction):} Continue the logical chain.
\item \textbf{Conclusion:} Restate what has been proven.
\end{enumerate}
```

Compiled example:

1. **Assumption/Given:** State the known facts or definitions.
2. **Step 1 (Manipulation):** Apply the first logical rule or algebraic step.
3. **Step 2 (Deduction):** Continue the logical chain.
4. **Conclusion:** Restate what has been proven.

3 Mathematics Environments

Inline Math

Use single dollar signs to include math within a line of text.

- `If $x \in \mathbb{Z}$, then $x^2 \ge 0$.`
- Renders as: If $x \in \mathbb{Z}$, then $x^2 \geq 0$.

Displayed Math

Use the `equation` environment or double dollar signs (`$$`) for a single centered equation.

```
$$ A + B = 2k + 2m + 2 $$
```

Alignment

Use the `align*` environment (from `amsmath`) to align multiple equations at the equals sign (`&`). Use `\\` to end a line.

```
\begin{align*}
    (x + 1)(x - 1) &= x^2 - x + x - 1 \\
                   &= x^2 - 1
\end{align*}
```

4 Key Mathematical Symbols

All of these symbols will be included in a reference guide on our testing page, so there is no need to memorize them.

Relations

- **Greater or Equal to:** `\ge` ($\ge$)
- **Less or Equal to:** `\le` ($\le$)
- **Not Equal to:** `\neq` ($\neq$)
- **Approximately Equal to:** `\approx` ($\approx$)

Set

- **Is an Element of:** `\in` ($\in$)
- **Subset of:** `\subset` ($\subset$)
- **Intersection:** `\cap` ($\cap$)
- **Union:** `\cup` ($\cup$)
- **Integers:** `\mathbb{Z}` ($\mathbb{Z}$)
- **Real Numbers:** `\mathbb{R}` ($\mathbb{R}$)
- **Natural Numbers:** `\mathbb{N}` ($\mathbb{N}$)

Functions and Combinatorics

- **Fraction:** `\frac{num}{den}` ($\frac{a}{b}$)
- **Square Root:** `\sqrt{argument}` ($\sqrt{x}$)
- **Superscript (Exponent):** `^exponent` (x^2)
- **Subscript (Index):** `_index` (T_n)
- **Sum Operator:** `\sum` ($\sum$)
- **Combinations (n choose k):** `\binom{n}{k}` ($\binom{n}{k}$)

Text within Math

To write normal text inside a math environment, use `\text{}`:

```
$$ \text{Since } n \text{ is even, } n = 2k $$
```

Renders as:

$$\text{Since } n \text{ is even, } n = 2k$$