

# Graduate Studies in Mathematics

The Author

Author Two

(A. U. Thor) AUTHOR ADDRESS LINE 1, AUTHOR ADDRESS LINE 2

*Current address*, A. U. Thor: Author current address line 1, Author  
current address line 2

*E-mail address*, A. U. Thor: `author@institute.edu`

*URL*: `http://www.author.institute`

*Dedicated to the memory of S. Bach.*

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The Author thanks V. Exalted.

ABSTRACT. Replace this text with your own abstract.

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## 1. Sample Mathematics and Text

This short sample document illustrates the typeset appearance of in-line and displayed mathematics in documents. It also illustrates five levels of section headings and three kinds of lists. Finally, the document includes entries for a manual bibliography and an appendix.

**1.1. In-line and Displayed Mathematics.** The expression  $\sum_{i=1}^{\infty} a_i$  is in-line mathematics, while the numbered equation

$$(0.1) \quad \sum_{i=1}^{\infty} a_i$$

is displayed and automatically numbered as equation 0.1.

Let  $H$  be a Hilbert space,  $C$  be a closed bounded convex subset of  $H$ ,  $T$  a nonexpansive self map of  $C$ . Suppose that as  $n \rightarrow \infty$ ,  $a_{n,k} \rightarrow 0$  for each  $k$ , and  $\gamma_n = \sum_{k=0}^{\infty} (a_{n,k+1} - a_{n,k})^+ \rightarrow 0$ . Then for each  $x$  in  $C$ ,  $A_n x = \sum_{k=0}^{\infty} a_{n,k} T^k x$  converges weakly to a fixed point of  $T$  [1].

Two sets of L<sup>A</sup>T<sub>E</sub>X parameters govern mathematical displays.<sup>1</sup> The spacing above and below a display depends on whether the lines above or below are short or long, as shown in the following examples.

A short line above:

$$x^2 + y^2 = z^2$$

and a short line below.

A long line above may depend on your margins

$$\sin^2 \theta + \cos^2 \theta = 1$$

as will a long line below. This line is long enough to illustrate the spacing for mathematical displays, regardless of the margins.

**1.2. Mathematics in section heads**  $\int_{\alpha}^{\beta} \ln t dt$ . Mathematics can appear in section heads. Note that mathematics in section heads may cause difficulties in typesetting styles with running headers or table of contents entries.

### 1.3. Theorems, Lemmata, and Other Theorem-like Environments.

A number of theorem-like environments is available. The following lemma is a well-known fact on differentiation of asymptotic expansions of analytic functions.

**Lemma 1.** *Let  $f(z)$  be an analytic function in  $\mathbb{C}_+$ . If  $f(z)$  admits the representation*

$$f(z) = a_0 + \frac{a_1}{z} + o\left(\frac{1}{z}\right),$$

---

<sup>1</sup>L<sup>A</sup>T<sub>E</sub>X automatically selects the spacing depending on the surrounding line lengths.

for  $z \rightarrow \infty$  inside a cone  $\Gamma_\varepsilon = \{z \in \mathbb{C}_+ : 0 < \varepsilon \leq \arg z \leq \pi - \varepsilon\}$  then

$$(0.2) \quad a_1 = -\lim_{z \rightarrow \infty, z \in \Gamma_\varepsilon} z^2 f'(z),$$

**Proof.** Change  $z$  for  $1/z$ . Then  $\Gamma_\varepsilon \rightarrow \bar{\Gamma}_\varepsilon = \{z \in \mathbb{C}_- : \bar{z} \in \Gamma_\varepsilon\}$  and

$$(0.3) \quad f(1/z) = a_0 + a_1 z + o(z).$$

Fix  $z \in \bar{\Gamma}_\varepsilon$ , and let  $C_r(z) = \{\lambda \in \mathbb{C}_- : |\lambda - z| = r\}$  be a circle with radius  $r = |z| \sin \varepsilon/2$ . It follows from (0.3) that

$$(0.4) \quad \frac{1}{2\pi i} \int_{C_r(z)} \frac{f(\lambda) d\lambda}{(\lambda - z)^2} = \sum_{m=0}^1 a_m \frac{1}{2\pi i} \int_{C_r(z)} \frac{(\lambda - z_0)^m d\lambda}{(\lambda - z)^2} + R(z),$$

where for the remainder  $R(z)$  we have

$$\begin{aligned} |R(z)| &\leq r^{-1} \max_{\lambda \in C_r(z)} o(|z|) = r^{-1} \max_{\lambda \in C_r(z)} |\lambda| \cdot O(|z| + r) \\ &= \frac{|z| + r}{r} \cdot O(|z| + r) = \frac{1 + \sin \varepsilon}{\sin \varepsilon} \cdot O(|z|). \end{aligned}$$

Therefore  $R(z) \rightarrow 0$  as  $z \rightarrow \infty$ ,  $z \in \bar{\Gamma}_{\varepsilon/2}$ , and hence by the Cauchy theorem (0.4) implies

$$\frac{d}{dz} f(1/z) = a_1 + R(z) \rightarrow a_1, \text{ as } z \rightarrow \infty, z \in \bar{\Gamma}_{\varepsilon/2},$$

that implies (0.2) by substituting  $1/z$  back for  $z$ . □

## 2. Section Headings

Use the Section tag for major sections, such as the one just above. Four additional heading levels are available, as described below.

**2.1. Subsection Heading.** This text appears under a subsection heading.

**2.1.1. Subsubsection Heading.** This text appears under a subsubsection heading.

Subsubsubsection Heading. This text appears under a subsubsubsection heading.

Subsubsubsubsection Heading. This text appears under a subsubsubsubsection heading.

## 3. Lists

Bullet, numbered and description list environments are available. Lists, which can extend four levels deep, look like this:

- (1) Numbered list item 1.
- (2) Numbered list item 2.

- (a) A numbered list item under a list item.  
The typeset appearance for this level is often different from the screen appearance. The typeset appearance often uses parentheses around the level indicator.
- (b) Another numbered list item under a list item.
  - (i) Third level numbered list item under a list item.
    - (A) Fourth and final level of numbered list items allowed.
- Bullet item 1.
- Bullet item 2.
  - Second level bullet item.
    - \* Third level bullet item.
      - Fourth and final level bullet item.

**Description List:** Each description list item has a lead-in followed by the item. Double-click the lead-in box to enter or customize the text of the lead-in.

**Bunyip:** Mythical beast of Australian Aboriginal legends.

#### 4. About the Bibliography

Following the text of this article is a short manual bibliography. This sample bibliography has no relationship to the previous text, but it shows sample citations such as [4], [5] and [6]. You can also have multiple citations appear together. Here is an example: [2, 3, 4].

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# Bibliography

- [1] N. Dunford and J. Schwartz, *Functional Analysis*, v. 2, John Wiley and Sons, New York, 1963.
- [2] Harstad, K. and Bellan, J., “Isolated fluid oxygen drop behavior in fluid hydrogen at rocket chamber pressures”, *Int. J. Heat Mass Transfer*, 1998a, **41**, 3537-3550
- [3] Harstad, K. and Bellan, J., “The Lewis number under supercritical conditions”, *Int. J. Heat Mass Transfer*, in print
- [4] Hirshfelder, J. O., Curtis, C. F. and Bird, R. B., *Molecular Theory of Gases and Liquids*, John Wiley and Sons, Inc., 1964
- [5] Prausnitz, J., Lichtenthaler, R. and de Azevedo, E., *Molecular thermodynamics for fluid-phase equilibrium*, Prentice -Hall, Inc., 1986
- [6] Reid, R. C., Prausnitz, J. M. and Polling, B. E., *The Properties of Gases and Liquids*, 4th Edition, McGraw-Hill Book Company, 1987

## 1. An Appendix

Because appendices may contain material that is supplementary rather than integral to the main text , many styles use a different numbering system for equations that appear in the appendices.

$$(.5) \quad \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The quadratic equation shown as equation .5 is used to demonstrate how equations are numbered in the appendix.