

**AN INTRODUCTION TO  
BRAILLE MATHEMATICS  
USING UEB WITH NEMETH**

**A Course for Transcribers**

*Second Edition, 2025*

**Revised by Lindy B. Walton**

**Barbara Taffet, advisor**

**[www.loc.gov/nls](http://www.loc.gov/nls)**

*National Library Service  
for the Blind and Print Disabled*

*The Library of Congress*



I believe that I could not have reached my potential in mathematics without the Nemeth code. With it, I am able to read and write mathematics, as well as other sciences, at all levels, limited only by my talent and my ambition.

—Dr. Abraham Nemeth, creator of the braille code for mathematics and science notation

## DEDICATION

I credit my interest in the continued training of braille transcribers in the Nemeth code to my friend and mentor, Helen Hay, whose fascination and enthusiasm about this braille code was contagious.

## THANKS

I offer my gratitude to the original authors of this lesson manual, Helen Roberts, Bernard M. Krebs, and Barbara Taffet, for their insight into the learning process and for their eye for detail. Many of the excellent examples from the original book are preserved in this edition. I am indebted to my NFB colleagues Dawn Gross, Cindi Laurent, and Jacquie Walker, for their patience and keen observations as we mentored our first students. I also wish to thank my supervisors and colleagues in the Madison Metropolitan School District for realizing the importance of the development of this curriculum. And to my husband, whose patience with my obsession has been tireless—thank you, John, for endless cups of coffee.

—Lindy Walton



## ABOUT THE PROGRAM

This course is designed for the UEB certified transcriber who is ready to take on the challenge of transcribing print mathematics and science materials into braille using *The Nemeth Braille Code for Mathematics and Science Notation 2022*. The program operates under a contract with the National Library Service for the Blind and Print Disabled, Library of Congress (NLS). All transcribing and proofreading course lessons and tests are administered under the National Federation of the Blind Braille Certification Training Program (BCTP). The following information is copied from the cover letter that the enrolled student will receive when accepted into the course. Up-to-date instructions will be sent at the time of enrollment.

The course is based on *The Nemeth Braille Code for Mathematics and Science Notation 2022* which is a publication of the Braille Authority of North America (BANA). Course materials do not supersede the authority of the official BANA code book.

### *Eligibility*

- United States citizenship or residency
- High school diploma or equivalent
- Knowledgeable in recommended braille formats for textbooks

### *Prerequisite*

- Library of Congress certification in literary braille transcribing (UEB) for a minimum of six months

### *Equipment*

Any of the following methods may be used in order to submit lesson exercises in braille: a forty-cell slate, a braillewriter, or a computer application that allows for direct input of 6-key braille. Use of back translation is allowed but 6-key entry is a necessity as well. A line length of forty cells is required, regardless of production method.

### *The Lesson Material*

The lessons are available by following the "Mathematics Braille Transcribing" link at [www.nfb.org/transcribers](http://www.nfb.org/transcribers). If you are unable to utilize the material from the website, please contact us at [transcribers@nfb.org](mailto:transcribers@nfb.org) or (410) 659-9314, extension 2510, and we will work with you to ensure you receive the material in a format that is usable for you.

Most lessons conclude with an exercise which is to be submitted to your grader for evaluation. You are encouraged to submit your work on a regular basis (at least monthly). You may submit only one lesson at a time.

Revisions to the online course lessons are occasionally necessary. The student should check the website to ensure that any lesson being completed is the current version. To report errors in this instruction manual, please send your message to [transcribers@nfb.org](mailto:transcribers@nfb.org).

### *Your Grader*

Students whose goal is to acquire certification in UEB with Nemeth must enroll through the NFB. After receiving your transcription of the first exercise, a grader will be assigned. Your grader will evaluate your first submission and will be your point of contact for the rest of the course.

### *How to Enroll*

Whether intending to take the course with a local teacher or through correspondence, prospective students must submit the application form before beginning the course. Applicants can enroll in the course in one of two ways.

- Complete the application online at <https://nfb.org/programs-services/braille-certification/mathematics-braille-transcribing>
- Or mail a print application to the address shown below.

National Federation of the Blind  
Braille Certification Training Program  
200 East Wells Street at Jernigan Place  
Baltimore, MD 21230

### *The Certification Test*

Upon completion of the course, the student may apply for the certification test. When requesting the test, students who have taken the course locally must include a letter from their Library of Congress certified mathematics braille instructor attesting that the student has successfully completed the course. Certification tests are distributed and evaluated by the National Federation of the Blind. Instructions for preparation and submission will accompany the exam. The Library of Congress is the certifying authority. Candidates scoring a passing grade will receive a Library of Congress certificate.

### *Further Information*

For more information about the braille certification training program, you may email, call, or write:

- email: [transcribers@nfb.org](mailto:transcribers@nfb.org)
- call: 410-659-9314, extension 2510
- write to the address shown above.

## FOREWORD TO THE 2024 EDITION

The first edition of the *Introduction to Braille Mathematics* was published in 1978 and was written by the late Helen Roberts and Bernard M. Krebs. It was my privilege to complete the text with Mr. Krebs after Helen passed away. Since that time, numerous corrections and updates have been made both to the Nemeth code itself and to this manual. Now, however, a major change has necessitated a complete rewriting of the lessons. 2016 was the implementation year in the United States for new transcriptions to be produced using the Unified English Braille Code. Because the Nemeth code works *within* UEB, many Nemeth rules must be modified.

After the first lesson most examples, practices, and exercises are shown in a text-like context. In this way, the student can see how the Nemeth code works in a real setting such as found in texts of many grade levels and complexities.

The practices within each lesson are available for self checking by the student. Answers to the practices are given at the end of each lesson. Braille reading practice is offered in Addendum 1. Most lessons conclude with an exercise which will be sent to you and evaluated by your teacher or by your NFB-assigned grader.

The student should understand that the Nemeth code itself is the authoritative source for all UEB with Nemeth transcriptions. The student should also be thoroughly familiar with the sourcebooks listed in the PREREQUISITES which follow this Foreword.

It has long been my hope that this manual could be brought into the present era. Lindy Walton, an experienced transcriber who works with the NLS Nemeth certification program, led the writing of this new edition. Once again, it is my honor to work with an exceptional member of the braille transcriber community.

Both Lindy and I thank the following for their support and help: Mary Denault, Peggy Jackson, Bill Jackson, Kyle DeJute, Julie Sumwalt, Lynnette Taylor, the members of the BANA Nemeth Code Technical Committee, the Grafton Braille Service Center, and the many students who participated in the beta testing of this course. Lastly, we direct our sincerest gratitude to the National Federation of the Blind which has lent support to the development and publication of this comprehensive manual.

—Barbara Taffet

## ABOUT THE 2025 EDITION

After field testing this course for several years and since the publication of the 2022 edition of *The Nemeth Braille Code for Mathematics and Science Notation*, corrections, changes, and clarifications are now available under one cover in this 2<sup>nd</sup> edition of *An Introduction to Braille Mathematics Using UEB With Nemeth*. Those familiar with the first release should replace it with this 2025 edition. A list of changes is available on the NFB website at [www.nfb.org/transcribers](http://www.nfb.org/transcribers).

## PREREQUISITES

A prerequisite to the study of UEB with Nemeth is certification in Unified English Braille, adequate experience in literary braille transcription, and confidence in your production method. Before beginning this course of study the student should also be thoroughly familiar with current methods for transcribing a textbook. Rules and guidelines are found in the following sourcebooks, all of which are available from the Braille Authority of North America (BANA) at [www.brailleauthority.org](http://www.brailleauthority.org). Dates shown below are the editions used as a resource in this lesson manual.

*The Rules of Unified English Braille, Second Edition 2013*

*Braille Formats: Principles of Print-to-Braille Transcription 2016*

*The Nemeth Braille Code for Mathematics and Science Notation 2022*

*Guidelines and Standards for Tactile Graphics 2022*

*Chemical Notation Using Nemeth Braille Code 2023*

## ABOUT THE EXAMPLES

To aid in discussion, lines are numbered in the examples which use four or more braille lines. There is no space shown on line 1 to accommodate a print page number unless page numbering is the topic at hand.

# CONTENTS

About the Program . . . . .	i
Foreword to the 2024 Edition . . . . .	iii
About the 2025 Edition . . . . .	iii
Prerequisites . . . . .	iv
About the Examples . . . . .	iv

## Preliminary Lesson

P1 Philosophy . . . . .	P-1
P2 Literary vs. Technical Texts . . . . .	P-1
<i>INTRODUCTION TO NUMERALS AND THE NUMERIC INDICATOR</i>	
P3 Representation of Arabic Numerals . . . . .	P-2
P4 Numeric Indicator . . . . .	P-3
<i>THE PRACTICE MATERIAL</i>	
<i>Practice A</i> . . . . .	P-4
<i>THE MATHEMATICAL COMMA AND DECIMAL POINT</i>	
P5 Mathematical Comma . . . . .	P-5
P6 Mathematical Decimal Point . . . . .	P-5
P7 <i>Format: General Principles</i> . . . . .	P-6
<i>Practice B</i> . . . . .	P-6
<i>INTRODUCTION TO SIGNS OF OPERATION</i>	
P8 Signs of Operation . . . . .	P-7
<i>Practice C</i> . . . . .	P-8
<i>INTRODUCTION TO SIGNS OF COMPARISON</i>	
P9 Signs of Comparison . . . . .	P-9
<i>Practice D</i> . . . . .	P-10
<i>MONETARY, PERCENT, AND PRIME SIGNS</i>	
P10 Monetary Signs . . . . .	P-11
P11 Percent and Per Mille Signs . . . . .	P-11
P12 Prime Sign . . . . .	P-12
<i>Practice E</i> . . . . .	P-12
<i>THE EUROPEAN COMMA AND DECIMAL</i>	
P13 The European Mathematical Comma . . . . .	P-13
P14 The European Decimal . . . . .	P-13
<i>THE TRANSCRIBER'S RESPONSIBILITY</i>	
P15 Follow Print . . . . .	P-14
Study Tips . . . . .	P-15
Answers to Practice Material . . . . .	P-17

## Lesson 1

<i>INTRODUCTION TO CODE SWITCHING</i>	
1.1 A Complete Transcription . . . . .	1-2
1.2 Use of the Code Switch Indicators . . . . .	1-2
<i>Practice 1A</i> . . . . .	1-3

1.3	Which Code? . . . . .	1-4
1.4	Placement of Literary Punctuation . . . . .	1-8
	<i>Practice 1B</i> . . . . .	1-8
1.5	<i>Format: Keep Together—General Principle Regarding Mathematical Expressions</i> . . . . .	1-9
	<i>Placement of the Switch Indicators</i> . . . . .	1-9
	<i>Practice 1C</i> . . . . .	1-13
1.6	Consistency with Mathematical Symbols . . . . .	1-14
	<i>Practice 1D</i> . . . . .	1-14
<i>THE HYPHEN AND THE DASH</i>		
1.7	The Hyphen and the Dash As Punctuation . . . . .	1-15
	<i>Practice 1E</i> . . . . .	1-18
<i>SIGNS OF OMISSION</i>		
1.8	General Rules Regarding Signs of Omission . . . . .	1-19
1.9	Ellipsis . . . . .	1-19
1.10	Long Dash . . . . .	1-20
1.11	General Omission Symbol . . . . .	1-20
1.12	Spacing of the Ellipsis and Long Dash . . . . .	1-22
1.13	Other Omission Symbols . . . . .	1-23
1.14	<i>Format: Paragraph Margins for Narrative Portions of Text (3-1)</i> . . . . .	1-24
	<i>Practice 1F</i> . . . . .	1-24
<i>INTRODUCTION TO IDENTIFIERS</i>		
1.15	Terminology . . . . .	1-25
1.16	<i>Format: Margins for Itemized Material with No Subdivisions (1-3)</i> . . . . .	1-25
	<i>Practice 1G</i> . . . . .	1-26
	Format Summary #1 . . . . .	1-27
	Instructions for Preparing the Exercises . . . . .	1-28
	Grading Guidelines . . . . .	1-29
	Answers to Practice Material . . . . .	1-31

## Lesson 2

### *MORE ABOUT PUNCTUATION*

2.1	Punctuation Mode . . . . .	2-2
2.2	Spacing of UEB Punctuation and Code Switch Indicators . . . . .	2-2
2.3	Nemeth Punctuation . . . . .	2-3
	<i>Practice 2A</i> . . . . .	2-4

### *PUNCTUATION IN NEMETH CODE*

2.4	Background . . . . .	2-5
<i>The Punctuation Indicator</i>		
2.5	Role of the Punctuation Indicator . . . . .	2-6
2.6	Punctuation with Omission Signs . . . . .	2-8
2.7	Punctuation and Spacing of Plural or Possessive Endings. . . . .	2-10
	<i>Practice 2B</i> . . . . .	2-11
2.8	Summary of the Use and Nonuse of the Punctuation Indicator . . . . .	2-11

### *INTRODUCTION TO SIGNS OF GROUPING*

2.9	Definition . . . . .	2-13
2.10	Signs of Grouping with Numerals . . . . .	2-13

2.11	Nested Grouping Symbols . . . . .	2-14
<i>Code-Switching Considerations</i>		
2.12	Enclosed Technical Material . . . . .	2-14
2.13	Paired Parentheses and Brackets . . . . .	2-16
<i>Spacing with Signs of Grouping</i>		
2.14	Spacing Inside of the Grouping Signs . . . . .	2-17
2.15	Spacing Outside of the Grouping Signs . . . . .	2-18
	<i>Practice 2C</i> . . . . .	2-19
<i>IDENTIFIERS, cont.</i>		
2.16	Code Switching with Itemized Material . . . . .	2-20
	<i>Practice 2D</i> . . . . .	2-24
2.17	Code Switching with Unitemized Listed Nemeth Items . . . . .	2-25
2.18	<i>Format: Side-by-Side Layout of Itemized Material</i> . . . . .	2-26
2.19	Identifiers and Braille Page Turns . . . . .	2-26
2.20	Braille Page Turns and Line 1 . . . . .	2-27
	<i>Summary of the Use/Nonuse of the Numeric Indicator</i> . . . . .	2-28
	<i>Answers to Practice Material</i> . . . . .	2-31

### Lesson 3

#### WORDS

3.1	Words in Narrative . . . . .	3-2
3.2	Words in Mathematical Context . . . . .	3-3
3.3	Punctuation With Words . . . . .	3-4
	<i>Practice 3A</i> . . . . .	3-5

#### *Introduction to Abbreviations*

3.4	Abbreviations . . . . .	3-6
3.5	Numbers with Ordinal Endings . . . . .	3-10
3.6	Non-Mathematical Number/Letter Combinations . . . . .	3-11
	<i>Practice 3B</i> . . . . .	3-11

#### *Single-Word Switch Indicator*

3.7	The Single-Word Switch Indicator . . . . .	3-12
3.8	More About Switch Indicators at Braille Page Turns . . . . .	3-17
	<i>Practice 3C</i> . . . . .	3-21
3.9	New Print Page . . . . .	3-22

#### LETTERS

3.10	Single English Letters in Narrative . . . . .	3-22
3.11	Single English Letters in Nemeth Code . . . . .	3-23

#### *Introduction to the English-letter Indicator*

3.12	<u>Use</u> of the English-letter Indicator with a "Single Letter" . . . . .	3-25
	<i>Practice 3D</i> . . . . .	3-26
3.13	<u>Nonuse</u> of the English-letter Indicator with a "Single Letter" . . . . .	3-26
3.14	Letters as Identifiers . . . . .	3-29
	<i>Practice 3E</i> . . . . .	3-29

#### *Mathematical Letter Combinations*

3.15	Mathematical Letter Sequence . . . . .	3-30
3.16	Capitalized Letter Sequence . . . . .	3-31

3.17 Shortform Letter Combinations . . . . .	3–31
<i>Practice 3F</i> . . . . .	3–33
Format Summary #2 . . . . .	3–33
Answers to Practice Material . . . . .	3–35

## Lesson 4

### MORE ABOUT LETTERS

#### *Variables*

4.1 Mathematical Variables . . . . .	4–2
<i>Practice 4A</i> . . . . .	4–3

#### *Roman Numerals*

4.2 Code Switching with Roman Numerals . . . . .	4–4
4.3 Capital Roman Numerals . . . . .	4–4
4.4 Lowercase Roman Numerals . . . . .	4–5
4.5 Punctuation with Roman Numerals . . . . .	4–6
4.6 Roman Numerals Used as Identifiers . . . . .	4–6
4.7 Mathematical Letter Combinations Similar to Roman Numerals . . . . .	4–7

<i>Review: Nonuse of the English-letter Indicator</i> . . . . .	4–8
<i>Practice 4B</i> . . . . .	4–8

#### *Nondecimal Bases*

4.8 Letters Used to Represent Numerals in Nondecimal Bases . . . . .	4–9
4.9 Nonalphabetic Symbols Used to Represent Numerals . . . . .	4–9
<i>Practice 4C</i> . . . . .	4–10

### OTHER ALPHABETS

4.10 Alphabetic Indicators . . . . .	4–11
4.11 The Greek Alphabet . . . . .	4–11
<i>Greek Alphabet Table</i> . . . . .	4–12
<i>Practice 4D</i> . . . . .	4–14
4.12 The German Alphabet . . . . .	4–15
4.13 The Hebrew Alphabet . . . . .	4–16
4.14 The Russian Alphabet . . . . .	4–16
<i>Practice 4E</i> . . . . .	4–17
4.15 A Sequence of Unspaced Letters . . . . .	4–18
4.16 Mathematical Constants . . . . .	4–19
<i>Practice 4F</i> . . . . .	4–19

### ENCLOSED LISTS

4.17 Special Case—Definition of "Enclosed List" . . . . .	4–20
<i>Practice 4G</i> . . . . .	4–25

### MORE ABOUT ENGLISH LETTERS

4.18 An English Letter Touching Only One Grouping Symbol . . . . .	4–26
4.19 English Letters with Plural, Possessive, or Ordinal Endings . . . . .	4–27
<i>Practice 4H</i> . . . . .	4–28

### MORE ABOUT ABBREVIATIONS

4.20 Spacing of Abbreviated Units of Measure and Operation Signs . . . . .	4–29
4.21 Single-Letter Abbreviations . . . . .	4–30
4.22 Abbreviations Whose Letters Correspond to a Shortform . . . . .	4–31

4.23	Context Clues . . . . .	4-31
4.24	Fully Capitalized Abbreviations – Acronyms and Initialisms . . . . .	4-32
<i>CODE SWITCHING, cont.</i>		
4.25	General Rule Regarding Blank Lines . . . . .	4-33
4.26	Transcriber’s Notes . . . . .	4-35
4.27	Embedded Identifiers . . . . .	4-35
	<i>Practice 4I</i> . . . . .	4-36
	Answers to Practice Material . . . . .	4-37

## Lesson 5

### *SIGNS OF OPERATION, cont.*

5.1	Review of Signs of Operation . . . . .	5-2
5.2	Signs of Operation Using Plus and Minus . . . . .	5-2
5.3	Signs of Operation That Look Like Literary Characters . . . . .	5-3
	<i>Practice 5A</i> . . . . .	5-7
5.4	Signs of Operation Unique to Mathematics . . . . .	5-8

### *Format: Simple Tables*

5.5	Introduction to Table Format . . . . .	5-14
	<i>Practice 5B</i> . . . . .	5-15

### *SIGNS OF COMPARISON, cont.*

5.6	More Comparison Signs . . . . .	5-16
5.7	Special Case—A Colon Meaning "Such That" . . . . .	5-20
	<i>Practice 5C</i> . . . . .	5-22
5.8	Signs of Comparison Compounded Vertically . . . . .	5-23
	<i>Practice 5D</i> . . . . .	5-28
5.9	Signs of Comparison Compounded Horizontally . . . . .	5-29
5.10	Negated Signs of Comparison . . . . .	5-29
	<i>Practice 5E</i> . . . . .	5-30

### *Format: Nemeth Instructions*

5.11	Margins for Instructions Preceding Itemized Material (5-3) . . . . .	5-31
5.12	Narrative Directions . . . . .	5-34
	<i>Practice 5F</i> . . . . .	5-36

	Answers to Practice Material . . . . .	5-37
--	--	------

## Lesson 6

### *Format:*

6.1	Margins for Itemized Material with Subdivisions (1-5; 3-5) . . . . .	6-2
	<i>Practice 6A</i> . . . . .	6-6

### *LEVEL INDICATORS*

6.2	Definition . . . . .	6-9
-----	----------------------	-----

### *Superscripts*

6.3	Superscript Level Indicator . . . . .	6-9
	<i>Practice 6B</i> . . . . .	6-10
6.4	Returning to the Baseline Level . . . . .	6-11
6.5	Raised Hollow Dot . . . . .	6-13

<i>Practice 6C</i> . . . . .	6–13
<i>Introduction to the Baseline Indicator</i>	
6.6 Function of the Baseline Indicator . . . . .	6–14
<i>Practice 6D</i> . . . . .	6–16
6.7 Higher Levels of Writing . . . . .	6–17
6.8 Certain Raised Signs . . . . .	6–18
<i>Practice 6E</i> . . . . .	6–19
<i>Subscripts</i>	
6.9 Subscript Level Indicators . . . . .	6–20
<i>Practice 6F</i> . . . . .	6–20
6.10 Returning to the Baseline Level . . . . .	6–21
<i>Practice 6G</i> . . . . .	6–22
6.11 Special Case—Nonuse of the Subscript Level Indicator . . . . .	6–22
<i>Practice 6H</i> . . . . .	6–25
6.12 Spaces Within Superscripts and Subscripts . . . . .	6–26
<i>Practice 6I</i> . . . . .	6–31
<i>More about Superscripts and Subscripts</i>	
6.13 Superscript and Subscript Combinations . . . . .	6–32
<i>Practice 6J</i> . . . . .	6–33
6.14 Left Superscripts and Subscripts . . . . .	6–33
6.15 Further Combinations . . . . .	6–34
6.16 Consecutive Superscripts and Subscripts . . . . .	6–35
6.17 Simultaneous Superscripts and Subscripts . . . . .	6–35
6.18 Nonsimultaneous Superscripts and Subscripts . . . . .	6–36
6.19 Detached Superscripts and Subscripts . . . . .	6–37
6.20 Literary Symbols and Level Indicators . . . . .	6–37
Summary . . . . .	6–37
<i>Practice 6K</i> . . . . .	6–38
6.21 More About Grouping Symbols and Level Indicators . . . . .	6–39
<i>Practice 6L</i> . . . . .	6–40
Answers to Practice Material . . . . .	6–41

## Lesson 7

### DISPLAYED FORMATS

7.1 Displayed Mathematical Material . . . . .	7–2
<i>Displayed Math Using 3-5 Margins</i> . . . . .	7–3
<i>Practice 7A</i> . . . . .	7–7
<i>Displayed Math Using 5-7 Margins</i> . . . . .	7–8
<i>Practice 7B</i> . . . . .	7–8
<i>Displayed Math Using 7-9 Margins</i> . . . . .	7–10
<i>Practice 7C</i> . . . . .	7–12
7.2 Displayed Material with Labels . . . . .	7–12
7.3 Displayed Narrative Material . . . . .	7–14
<i>Practice 7D</i> . . . . .	7–15

### TYPEFORM

7.4 General Guidelines Regarding Typeform . . . . .	7–16
---	------

7.5	The Five Mathematical Typeform Indicators . . . . .	7–17
7.6	Typeform of Letters . . . . .	7–17
	<i>Practice 7E</i> . . . . .	7–19
	<i>Practice 7F</i> . . . . .	7–20
	<i>Practice 7G</i> . . . . .	7–25
7.7	Typeform of Numerals . . . . .	7–26
	<i>Practice 7H</i> . . . . .	7–28
7.8	Nonregular Typeform in Contact with a Grouping Symbol . . . . .	7–28
	<i>Practice 7I</i> . . . . .	7–30
7.9	Boldface Mathematical Symbols . . . . .	7–30
	<i>Practice 7J</i> . . . . .	7–32
7.10	Barred Grouping Symbols and Other Signs of Grouping . . . . .	7–32
	<i>Practice 7K</i> . . . . .	7–34
7.11	Further Details Regarding Typeform of Letters and Numerals . . . . .	7–35
	<i>Practice 7L</i> . . . . .	7–38
	Answers to Practice Material . . . . .	7–39

## Lesson 8

### INTRODUCTION TO FRACTIONS

#### *Simple Fractions*

8.1	Definition . . . . .	8–2
8.2	Simple Fraction Indicators . . . . .	8–3
8.3	The Horizontal Simple Fraction Line . . . . .	8–3
	<i>Practice 8A</i> . . . . .	8–5
8.4	The Diagonal Simple Fraction Line . . . . .	8–6
	<i>Practice 8B</i> . . . . .	8–11

#### *Mixed Numbers*

8.5	Definition of Mixed Number . . . . .	8–12
	<i>Practice 8C</i> . . . . .	8–13

#### *Complex Fractions*

8.6	Definition of Complex Fraction . . . . .	8–14
	<i>Practice 8D</i> . . . . .	8–16

#### *More Fraction Rules*

8.7	Fractions and the Baseline Indicator . . . . .	8–17
8.8	Further Observations Regarding Spacing . . . . .	8–17
8.9	Fractions and the Ellipsis and Long Dash . . . . .	8–18
8.10	Fractions in an Enclosed List . . . . .	8–19
	<i>Practice 8E</i> . . . . .	8–20

### RADICAL EXPRESSIONS

8.11	Terminology . . . . .	8–21
8.12	The Termination Indicator . . . . .	8–21
8.13	Spacing . . . . .	8–22
8.14	Index of Radical . . . . .	8–22
	<i>Practice 8F</i> . . . . .	8–23
8.15	Nested Radical Expressions . . . . .	8–24
8.16	Radical Expressions and the Baseline Indicator . . . . .	8–24
8.17	Radical Expressions and the Ellipsis and Long Dash . . . . .	8–25

8.18	Radical Expressions and Abbreviations . . . . .	8–25
8.19	Enclosed Lists with Radical Expressions . . . . .	8–26
	<i>Practice 8G</i> . . . . .	8–26
<i>LINKED EXPRESSIONS</i>		
8.20	Definition of Linked Expression . . . . .	8–27
8.21	Division of Linked Expressions . . . . .	8–27
	<i>Practice 8H</i> . . . . .	8–30
8.22	Special Case—Nested Linked Expressions . . . . .	8–31
	<i>Practice 8I</i> . . . . .	8–35
	<i>Practice 8J</i> . . . . .	8–40
	Answers to Practice Material . . . . .	8–41

## Lesson 9

### *ARROWS*

9.1	Arrows Used in Mathematics . . . . .	9–2
9.2	Construction of Braille Arrows . . . . .	9–2
9.3	Spacing and Punctuation with Arrows . . . . .	9–2
9.4	Horizontal Arrow Shafts . . . . .	9–2
9.5	Barbed and Solid Arrowheads . . . . .	9–3
9.6	Special Case—The Contracted Form of the Right-Pointing Arrow. . . . .	9–5
	<i>Practice 9A</i> . . . . .	9–6
9.7	Blunted, Straight, and Curved Arrowheads . . . . .	9–7
9.8	Arrows With Dotted Ends . . . . .	9–8
	<i>Practice 9B</i> . . . . .	9–9

### *Vertical, Slanted, and Curved Arrow Shafts*

9.9	Arrow Direction Indicators . . . . .	9–10
	<i>Practice 9C</i> . . . . .	9–12

### *Boldface and Compounded Arrows*

9.10	Boldface Arrow . . . . .	9–13
9.11	Arrows Used as Signs of Comparison Compounded Vertically . . . . .	9–13
9.12	Arrows Used as Signs of Comparison Compounded Horizontally . . . . .	9–14
9.13	Nonmathematical Arrows . . . . .	9–15

### *INTRODUCTION TO SPATIAL ARRANGEMENTS*

9.14	Background . . . . .	9–16
------	----------------------	------

### *Spatial Arrangements with Addition and Subtraction*

9.15	Separation Line . . . . .	9–17
9.16	Alignment with Addition and Subtraction . . . . .	9–17
9.17	Placement of Symbols . . . . .	9–18
9.18	Side-by-Side Layout . . . . .	9–20
	<i>Practice 9D</i> . . . . .	9–22
9.19	Omissions in Work Arranged Spatially for Computation . . . . .	9–23
9.20	Spatially Arranged Polynomials . . . . .	9–24
9.21	Abbreviations . . . . .	9–26
9.22	Fractions . . . . .	9–26
9.23	Placement of Identifiers . . . . .	9–29
	<i>Practice 9E</i> . . . . .	9–31
9.24	Regrouping Numbers in Addition Problems . . . . .	9–32

<i>Introduction to Cancellation</i>	
9.25 Cancellation in Subtraction Problems . . . . .	9–34
<i>Practice 9F</i> . . . . .	9–36
<i>Arrangement on the Page</i>	
9.26 Blank Lines . . . . .	9–37
9.27 Wide Arrangements . . . . .	9–39
9.28 Itemized Spatial Problems with Subdivisions . . . . .	9–41
<i>Placement of Code Switch Indicators</i>	
9.29 Code Switching with Unitemized Spatial Arrangements . . . . .	9–43
9.30 Code Switching with Itemized Spatial Arrangements . . . . .	9–46
9.31 Code Switching with Cell-5 and Cell-7 Headings . . . . .	9–48
9.32 Code Switching and the Page Change Indicator . . . . .	9–49
Answers to Practice Material . . . . .	9–51

## Lesson 10

### *SPATIAL ARRANGEMENTS, continued*

<i>Review of Format for Spatial Arrangements</i> . . . . .	10–2
<i>SPATIAL ARRANGEMENT WITH MULTIPLICATION</i>	
10.1 Alignment . . . . .	10–2
10.2 Placement of Multiplication Symbol . . . . .	10–2
10.3 Separation Line . . . . .	10–3
<i>Alignment of Partial Products</i>	
10.4 Partial Products . . . . .	10–4
<i>Practice 10A</i> . . . . .	10–5
10.5 Omissions in Spatial Multiplication Problems . . . . .	10–6
10.6 Fractions and Mixed Numbers . . . . .	10–6
10.7 Polynomials . . . . .	10–7
10.8 Subscripts Denoting Nondecimal Bases . . . . .	10–8
10.9 Regrouping Numbers with Multiplication . . . . .	10–8
10.10 Placement of Identifiers with Spatial Multiplication . . . . .	10–10
<i>Practice 10B</i> . . . . .	10–11
<i>DIVISION PROBLEMS</i>	
10.11 Notation Devices . . . . .	10–12
10.12 Linear (Nonspatial) Representation of Division Problems . . . . .	10–12
<i>Practice 10C</i> . . . . .	10–14
10.13 Spatial Representation of Division Problems . . . . .	10–15
<i>Practice 10D</i> . . . . .	10–24
10.14 Omissions in Spatial Division Problems . . . . .	10–25
10.15 Regrouping in Division . . . . .	10–25
10.16 Cancellation in Long Division . . . . .	10–27
10.17 Placement of Identifiers with Spatial Division . . . . .	10–29
10.18 Other Layouts . . . . .	10–29
<i>Practice 10E</i> . . . . .	10–29
<i>REVISITING SOME RULES</i>	
10.19 Summary of the Use and Nonuse of the Numeric Indicator . . . . .	10–30
10.20 Review of Rules for Signs of Grouping . . . . .	10–32

Answers to Practice Material . . . . .	10–33
--	-------

## Lesson 11

### *SIGNS OF SHAPE*

11.1 Definition . . . . .	11–2
---------------------------	------

#### *Basic Shapes*

11.2 Basic Signs of Shape Represented by Numbers—Regular Polygons . . . . .	11–2
11.3 Basic Signs of Shape Represented by Letters—Irregular Polygons . . . . .	11–3
11.4 Other Basic Signs of Shape Represented by Letters . . . . .	11–4
11.5 Basic Signs of Shape Represented by Other Dot Combinations . . . . .	11–6
11.6 Filled-In and Shaded Shapes . . . . .	11–6
<i>Practice 11A</i> . . . . .	11–7

#### *Shapes with Structural Modification*

11.7 Definition and Construction . . . . .	11–8
11.8 Structurally Modified Triangles . . . . .	11–9
11.9 Structurally Modified Angles . . . . .	11–10
11.10 Unlisted Shapes with Structural Modification . . . . .	11–10
<i>Practice 11B</i> . . . . .	11–11

#### *Shapes with Interior Modification*

11.11 Definition and Construction . . . . .	11–12
11.12 Circles with Interior Modification . . . . .	11–13
11.13 Two or More Vertically Arranged Modifiers . . . . .	11–14
11.14 Angles with Interior Modification . . . . .	11–14
11.15 Rectangles and Squares with Interior Modification . . . . .	11–15
11.16 Two or More Horizontally Arranged Modifiers . . . . .	11–15
11.17 Unlisted Shapes with Interior Modification . . . . .	11–16
11.18 Words Enclosed in Shapes . . . . .	11–16
<i>Practice 11C</i> . . . . .	11–16

#### *Other Details*

11.19 Spacing with Signs of Shape . . . . .	11–17
11.20 Punctuation with Signs of Shape . . . . .	11–17
11.21 Plurals/Possessives . . . . .	11–17
11.22 Further Considerations Regarding Transcriber-Devised Shapes . . . . .	11–18
<i>Practice 11D</i> . . . . .	11–19

#### *Identified Signs of Shape*

11.23 Spacing . . . . .	11–20
11.24 A Shape Within a Superscript or a Subscript . . . . .	11–21
11.25 A Shape Which Carries a Superscript or a Subscript . . . . .	11–21
11.26 The English-letter Indicator . . . . .	11–21
11.27 Use of the Numeric Indicator in an Enclosed List . . . . .	11–22
<i>Practice 11E</i> . . . . .	11–23

#### *Shapes Used as Signs of Omission*

11.28 Usage and Spacing . . . . .	11–24
11.29 The English-letter Indicator and Comparison Signs . . . . .	11–25
11.30 Use of the Multipurpose Indicator . . . . .	11–26
11.31 Omissions in Spatially Arranged Problems . . . . .	11–26

<i>Practice 11F</i> . . . . .	11–27
<i>Calculators and Keyboards</i>	
11.32 The Keystroke Indicator . . . . .	11–28
11.33 Other Details Concerning Keystrokes . . . . .	11–28
11.34 Long Keystroke Constructions . . . . .	11–30
<i>Icons</i>	
11.35 Consistency in Representation of Icons . . . . .	11–30
<i>Practice 11G</i> . . . . .	11–31
<i>Practice 11H</i> . . . . .	11–31
<i>TYPEFORM INDICATORS FOR MATHEMATICAL WORDS AND PHRASES</i>	
11.36 Italic and Boldface Typeform Indicators . . . . .	11–32
11.37 Code Switching Within an Emphasized UEB Passage . . . . .	11–37
<i>Mathematical Statements</i>	
11.38 Axioms, Corollaries, Definitions, Laws, Lemmas, Propositions, Theorems . . . . .	11–38
<i>Practice 11I</i> . . . . .	11–41
Answers to Practice Material . . . . .	11–43

## Lesson 12

### *MODIFIERS AND MODIFIED EXPRESSIONS*

12.1 Definition . . . . .	12–2
12.2 Construction of Simple Modified Expressions – The Five-Step Rule . . . . .	12–2
<i>Common Modifiers</i>	
12.3 Arrows as Modifiers . . . . .	12–3
<i>Practice 12A</i> . . . . .	12–7
12.4 Carets as Modifiers . . . . .	12–8
12.5 Horizontal Bar as a Modifier . . . . .	12–8
<i>Practice 12B</i> . . . . .	12–12
12.6 Other Symbols Used as Modifiers . . . . .	12–13
12.7 Expressions as Modifiers . . . . .	12–16
<i>Practice 12C</i> . . . . .	12–18
12.8 Spacing with Modified Expressions . . . . .	12–19
<i>Practice 12D</i> . . . . .	12–19
<i>Modified Expressions and Superscripts/Subscripts</i>	
12.9 Modified Expression on the Baseline of Writing . . . . .	12–20
<i>Practice 12E</i> . . . . .	12–22
12.10 Modified Expression Within a Superscript or Subscript . . . . .	12–24
<i>Practice 12F</i> . . . . .	12–25
<i>Modified Signs of Comparison</i>	
12.11 Definition . . . . .	12–26
12.12 Transcription . . . . .	12–26
<i>Practice 12G</i> . . . . .	12–28
<i>Expressions with More Than One Modifier</i>	
12.13 Modifiers of Higher Order . . . . .	12–29
12.14 Individual Modifiers . . . . .	12–30
12.15 Simultaneous Modifiers . . . . .	12–31
<i>Practice 12H</i> . . . . .	12–33

<i>Format</i>	
12.16 Formal Proof . . . . .	12–34
<i>Practice 12I</i> . . . . .	12–37
<i>Practice 12J</i> . . . . .	12–37
POSTSCRIPT: Vector Notation Notes . . . . .	12–38
Answers to Practice Material . . . . .	12–41

## Lesson 13

### MISCELLANEOUS SYMBOLS

#### *Unspaced Symbols*

13.1 Spacing Rules for Unspaced Symbols . . . . .	13–2
<i>Practice 13A</i> . . . . .	13–10

#### *Spaced Symbols*

13.2 Spacing Rules for Spaced Symbols . . . . .	13–11
<i>Practice 13B</i> . . . . .	13–13

#### *Spacing with the Angstrom Unit and Tally Marks*

13.3 Angstrom Unit . . . . .	13–14
13.4 Tally Mark . . . . .	13–15
<i>Practice 13C</i> . . . . .	13–16

### SUPERPOSED SIGNS

13.5 Definition and Analysis . . . . .	13–17
13.6 Transcription of Superposed Signs . . . . .	13–18
<i>Practice 13D</i> . . . . .	13–21

### AMBIGUOUS SIGNS

13.7 Context . . . . .	13–22
------------------------	-------

### MULTIPURPOSE INDICATOR

13.8 Review . . . . .	13–24
13.9 Additional Uses of the Multipurpose Indicator . . . . .	13–24
<i>Practice 13E</i> . . . . .	13–26

### REFERENCE SIGNS AND SYMBOLS

13.10 Usage and Code Switching . . . . .	13–27
<i>Practice 13F</i> . . . . .	13–30
Answers to Practice Material . . . . .	13–31

## Lesson 14

### FUNCTION NAMES AND THEIR ABBREVIATED FORMS

14.1 List of Common Function Names and Their Abbreviated Forms . . . . .	14–2
14.2 Code Switching and Punctuation . . . . .	14–3
<i>Practice 14A</i> . . . . .	14–5
14.3 Spacing of Function Names . . . . .	14–6
<i>Practice 14B</i> . . . . .	14–9
14.4 Nonuse of the English-letter Indicator . . . . .	14–10
14.5 Keep Together . . . . .	14–11
14.6 Clarification—Function Names in an Enclosed List . . . . .	14–12
<i>Practice 14C</i> . . . . .	14–12

14.7	Superscripts and Subscripts . . . . .	14–13
	<i>Practice 14D</i> . . . . .	14–16
14.8	Modifiers . . . . .	14–17
	<i>Practice 14E</i> . . . . .	14–18
<i>Spatial Arrangements, cont.</i>		
<i>SQUARE ROOT DIVISION</i>		
14.9	Review of Terminology . . . . .	14–19
14.10	Spatial Arrangement for Square Root Problems . . . . .	14–19
14.11	Placement of Identifiers with Spatial Radical Expressions . . . . .	14–21
	<i>Practice 14F</i> . . . . .	14–22
<i>OTHER PRINT LAYOUTS SHOWING DIVISION</i>		
14.12	Partial Quotients . . . . .	14–23
	<i>Practice 14G</i> . . . . .	14–24
14.13	Synthetic Division . . . . .	14–25
	<i>Practice 14H</i> . . . . .	14–28
Answers to Practice Material . . . . .		14–29

## Lesson 15

### *MATHEMATICAL EXPRESSIONS REQUIRING RUNOVERS*

15.1	Review . . . . .	15–2
15.2	Mathematical Units . . . . .	15–3
15.3	Step a: Divide Before a Comparison Sign on the Baseline . . . . .	15–4
	<i>Practice 15A</i> . . . . .	15–9
15.4	Step b: Divide Before an Operation Sign on the Baseline . . . . .	15–10
	<i>Practice 15B</i> . . . . .	15–14
15.5	Step c: Divide Before a Mathematical Unit . . . . .	15–15
	<i>Practice 15C</i> . . . . .	15–21
	<i>Practice 15D</i> . . . . .	15–21
15.6	Step d: Divide After a Termination Indicator . . . . .	15–22
	<i>Practice 15E</i> . . . . .	15–23
15.7	Function Notation, Integral Notation, Sigma Notation, and Pi Notation . . . . .	15–24
	<i>Practice 15F</i> . . . . .	15–24
	<i>Practice 15G</i> . . . . .	15–26
	<i>Practice 15H</i> . . . . .	15–28
	<i>Practice 15I</i> . . . . .	15–29
SUMMARY . . . . .		15–30
Answers to Practice Material . . . . .		15–31

## Lesson 16

### *SPATIAL ARRANGEMENT OF FRACTIONS*

16.1	Spatial Fraction Line . . . . .	16–2
16.2	Numerator and Denominator . . . . .	16–2
16.3	Placement of Identifiers with Spatially Arranged Fractions . . . . .	16–3
<i>Situations Requiring Spatial Presentation of Simple Fractions</i>		
16.4	Fractions Arranged Spatially for Illustration . . . . .	16–4
	<i>Practice 16A</i> . . . . .	16–5

16.5	Cancellation With Replacement Values . . . . .	16–5
	<i>Practice 16B</i> . . . . .	16–8
	<i>Practice 16C</i> . . . . .	16–9
16.6	Cancellation Without Replacement Values . . . . .	16–9
	<i>Practice 16D</i> . . . . .	16–11
<i>HYPERCOMPLEX FRACTIONS</i>		
16.7	Definition and Recognition . . . . .	16–12
16.8	Transcription of Hypercomplex Fractions . . . . .	16–13
16.9	Higher Orders of Complexity . . . . .	16–15
	<i>Practice 16E</i> . . . . .	16–15
<i>CONTINUED FRACTIONS</i>		
16.10	Definition and Recognition . . . . .	16–16
	<i>Practice 16F</i> . . . . .	16–18
<i>INSTRUCTIONAL COMMENTARY</i>		
16.11	Format for Instructional Commentary . . . . .	16–19
	<i>Practice 16G</i> . . . . .	16–23
<i>STEM-AND-LEAF PLOTS</i>		
16.12	Recognition . . . . .	16–24
16.13	The Table . . . . .	16–24
16.14	The Key . . . . .	16–25
16.15	Data Consisting of More Than One Character; Punctuation Between Entries . . . . .	16–27
16.16	Alphabetic Data . . . . .	16–28
16.17	Blank Entries . . . . .	16–28
16.18	Runovers Within the Table . . . . .	16–30
16.19	Back-To-Back Plot . . . . .	16–31
	<i>Practice 16H</i> . . . . .	16–33
	Answers to Practice Material . . . . .	16–35

## Lesson 17

### *SYSTEM OF EQUATIONS*

17.1	Definition and Recognition . . . . .	17–2
17.2	Transcription Rules for Systems of Equations . . . . .	17–2
	<i>Practice 17A</i> . . . . .	17–5

### *Enlarged Signs of Grouping*

17.3	A Unified Expression . . . . .	17–5
17.4	Transcription Rules for Enlarged Signs of Grouping . . . . .	17–5
17.5	Embedded Vertical Groupings . . . . .	17–7
	<i>Practice 17B</i> . . . . .	17–8
17.6	Enlarged Parentheses . . . . .	17–8
17.7	Placement of Symbols . . . . .	17–8
17.8	Placement of Identifiers and Punctuation . . . . .	17–9
17.9	Nested Grouping Symbols . . . . .	17–11
	<i>Practice 17C</i> . . . . .	17–11
17.10	Conditions or Commentary Printed Next to a Spatial Arrangement . . . . .	17–12
	<i>Practice 17D</i> . . . . .	17–18
17.11	More Enlarged Signs of Grouping . . . . .	17–19
	<i>Practice 17E</i> . . . . .	17–21

DETERMINANTS AND MATRICES

17.12	Definition and Recognition . . . . .	17–21
17.13	Transcription Rules for Determinants and Matrices . . . . .	17–21
	<i>Practice 17F</i> . . . . .	17–26
	<i>Practice 17G</i> . . . . .	17–26
<i>Further Considerations with Determinants and Matrices</i>		
17.14	Multiplying Arrays . . . . .	17–27
17.15	Ellipses, Single Dots, and Blank Entries . . . . .	17–28
	<i>Practice 17H</i> . . . . .	17–31
	<i>Practice 17I</i> . . . . .	17–31
17.16	Augmented Matrix . . . . .	17–32
17.17	Runovers in Arrays . . . . .	17–32
	<i>Practice 17J</i> . . . . .	17–37
	<i>Practice 17K</i> . . . . .	17–37
17.18	Row Matrix . . . . .	17–38
17.19	Embedded Arrays . . . . .	17–38
	<i>Practice 17L</i> . . . . .	17–39
	<i>Practice 17M</i> . . . . .	17–40
17.20	Use of Tactile Graphics for Enlarged Grouping Signs . . . . .	17–40
Answers to Practice Material . . . . .		17–41

**Lesson 18**

*TABLES*

18.1	Structure of Tables . . . . .	18–2
18.2	Table Label and Title . . . . .	18–2
18.3	Column Headings . . . . .	18–3
18.4	Table Entries . . . . .	18–3
	<i>Practice 18A</i> . . . . .	18–9
18.5	When Row Headings are Words . . . . .	18–9
	<i>Practice 18B</i> . . . . .	18–10

*Boxed Tables*

18.6	Code Switching and Box Lines . . . . .	18–11
	<i>Practice 18C</i> . . . . .	18–19

*More Table Rules Specific to the Nemeth Code*

18.7	A Table of Numbers . . . . .	18–20
	<i>Practice 18D</i> . . . . .	18–22

*FIGURES AND DIAGRAMS*

18.8	Which Code? . . . . .	18–23
18.9	Switch Indicators and Tactile Graphics . . . . .	18–24
	<i>Practice 18E</i> . . . . .	18–26
18.10	Number Lines . . . . .	18–27
	<i>Practice 18F</i> . . . . .	18–29
	<i>Practice 18G</i> . . . . .	18–29
18.11	Diagrams in Exercise Material . . . . .	18–29
18.12	Molecular Diagrams . . . . .	18–29

*KEYING TECHNIQUE*

18.13	Keying . . . . .	18–30
-------	------------------	-------

<i>Practice 18H</i> . . . . .	18–35
Answers to Practice Material . . . . .	18–37

## Lesson 19

19.1 Preparing for the Certification Test . . . . .	19–1
19.2 The Nemeth Code Book . . . . .	19–1
19.3 Beyond the Nemeth Code . . . . .	19–3
<i>Structuring a Textbook</i>	
19.4 Transcriber-Generated Pages and Front Matter . . . . .	19–4
<i>Practice 19A.</i> . . . . .	19–5
19.5 Body of Text . . . . .	19–7
<i>Four Practices</i> . . . . .	19–9
<i>Practice 19B.</i> . . . . .	19–10
<i>Practice 19C.</i> . . . . .	19–11
<i>Practice 19D.</i> . . . . .	19–12
<i>Practice 19E.</i> . . . . .	19–14
Answers to Practice Material . . . . .	19–15

## Addenda

- Addendum 1—Reading Practice
- Addendum 2—Glossary Of Terms; About Dr. Abraham Nemeth
- Addendum 3—Nemeth Code Format Summaries

To report errors in this instruction manual,  
 please send your message to [transcribers@nfb.org](mailto:transcribers@nfb.org).