BASIC MATHEMATICS

STEVE SLAVIN ▲ GINNY CRISONINO

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STEVE SLAVIN
Professor Emeritus
Union County College

GINNY CRISONINO
Associate Professor
Union County College

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Preface to the Instructor

Why is this text different from all other basic mathematics texts? We all cover the same work, but our book is formatted to meet the needs of today's college students. They need a less intimidating text with a steady stream of positive reinforcement. Their needs are not met by a text that is cluttered with bells and whistles, or one so verbose that it puts our students to sleep.

Our pedagogy is simple: You learn math by doing math. Students need to realize that they can do the work. By working their way through the text, checking their work, correcting their own mistakes, and mastering the material on their own, they will keep getting positive reinforcement. And we are right there with them, anticipating and then answering their questions, and, in effect, having a mathematical conversation.

Each chapter has an identical format. A section begins with a few illustrative examples, which come with full solutions. Next comes a problem set, which the student is asked to complete, followed by the full solutions to each of these problems. The next subsections are set up the same way. At the end of each section is a set of workbook questions, which can be done in class or for homework. Each chapter ends with a chapter review and two chapter tests. These can also be done in class or for homework, and provide more positive reinforcement.

Unlike all the other basic mathematics books out there, ours covers the most important topics such as order of operations and division by zero throughout the book, not just in one section of one chapter. In the back of the book, we have the step-by-step solutions, not just the answers. Instead of putting the applications at the end of each section, we have a whole section of each chapter dedicated to applications. That way, students have to figure out which operations are needed for each problem.

Basic mathematics is arguably the hardest course to teach, since you are expected to cover up to eight years of math in just one semester. Because our formatting encourages students to work their way through our text, you'll find that our text basically teaches itself. If this makes your job any easier, and if more students are prepared to tackle algebra, then this text really is different from all other basic mathematics texts.

Preface to the Student

You can't learn how to drive a car by reading a driver's manual or watching a movie in driver's ed. You need to actually get behind the wheel and start driving. Learning math is a lot like learning to drive. You learn math by doing math. We'll show you how to solve a problem. Then we'll ask you to solve similar problems. After you do math for a while, you'll get good at it. Like learning to drive, at first it looks very intimidating. But once you start doing it, you'll be amazed at how easy it is.

Learning math is like putting up a building. You need to build a strong foundation. Once you've built that foundation, there's no telling how high you can build.

Acknowledgements

As soon as we finished writing the last chapter of this book, we congratulated each other on finally completing about three years of work. But our celebration was premature. A whole new team needed to shape our manuscript into a polished textbook. There would be reviewers, professors who would test our book in their classes, students providing feedback, compositors, graphic artists, and printers. It would be impossible to acknowledge each individual who helped, but we're going to try anyway.

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Have you noticed the pizza pie on the cover? Our cover designer, Michael Warrell baked that pie, so to speak

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Sharon Testone, Onondaga Community College, Syracuse, NY 13215
Nancy Desilet, Carroll Community College, Westminster, MD
Margaret Finster, Erie Community College, Orchard Park, NY
Beth Hempleman, Mira Costa College, Oceanside, CA 92056
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Karen S. Hale, State University of New York, Morrisville, NY
Mike Iannone, The College of New Jersey, Ewing, NJ
Susan A. Sherman, Middlesex Community College, Fords, NJ

About the Authors

Steve Slavin, Ph.D. is Professor Emeritus of Economics at Union County College in Cranford, New Jersey. He is the author of Quick Business Math, Math for Your First- and Second-Grader, and All the Math You'll Ever Need, published by John Wiley and Sons, and Economics, published by McGraw-Hill.

Ginny Crisonino has taught mathematics at Union County College since 1983, and has completed most of her work toward a Ph.D. at New York Polytechnic University. She and Steve Slavin have coauthored Precalculus, A Self-Teaching Guide and Geometry, A Self-Teaching Guide, both published by John Wiley and Sons.

Instructor's Manual

At the back of the text we provide full solutions to all the odd-numbered workbook problems and to all the chapter review problems. In the Instructor's Manual, you'll find the answers to the even-numbered workbook problems and to the chapter tests. In addition, there are four chapter tests for each chapter.

CHAPTER 1. **Addition and Subtraction of Whole Numbers 3**

1.1 Place Value 1

1.2 Rounding 7

Rounding Numbers with Nines 8

1.3 Addition 11

The Addition Table 11

Adding Whole Numbers 11

Addition with Carrying (Regrouping) 12

1.4 Subtraction 17

Subtraction with Borrowing 18

1.5 Applications 23

Chapter Review 27

Chapter Test 1 29

Chapter Test 2 33

CHAPTER 2. **Multiplication and Division of Whole Numbers 37**

2.1 Multiplication with Whole Numbers 37

The Multiplication Table 37

Multiplying Whole Numbers by Powers of Ten 40

Multiplying by Numbers that End in Zero 40

2.2 Exponents 45

2.3 Squares and Roots of Whole Numbers 49

2.4 Division with Whole Numbers 57

Division with Zeros 59

Dividing Whole Numbers by Powers of Ten 60

Averages 61

Estimation 62

2.5 Arithmetic Properties 69

Addition Property of Zero 69

Commutative Property of Addition 69

Commutative Property of Multiplication 69

Associative Property of Addition 70

Associative Property of Multiplication 70

Multiplication Property of One 71

Multiplication Property of Zero 71

2.6 Order of Operations 75

2.7 Applications 81

Applications in Addition and Subtraction 81

Applications in Multiplication and Division 83

Chapter Review 89

Chapter Test 1 92

Chapter Test 2 95

CHAPTER 3. **Proper Fractions 99**

3.1 Picturing Fractions 100

3.2 Fractions in Words and Numbers 101

3.3 Prime Numbers and Factoring 109

3.3a Using the Factor Tree 109

3.3b Finding the Main Prime Factors 115

3.3c Finding Prime Factors Using Continued Division 121

3.4 Reducing Fractions 122

3.5 Multiplying Proper Fractions 127

3.6 Multiplying Fractions 134

3.6a Using Prime Factoring 134

3.6b Reducing Common Factors 139

3.6c Multiplication of Three Fractions 145

3.7 Multiplying with Exponents 149

3.7a Squares 149

3.7b Cubes 15

3.7c Roots of Fractions 161

3.8 Division with Fractions 165

3.9 Addition and Subtraction of Fractions 173

3.9a With Common Denominators 173

3.9b Addition and Subtraction of Fractions without Common Denominators 179

3.10 Order of Operations Applied to Fractions 195

3.11 Applications for Fractions 201

Chapter Review 207

Chapter Test 1 211

Chapter Test 2 215

CHAPTER 4. **Improper Fractions, Complex Fractions, and Mixed Numbers 219**

4.1 Converting Improper Fractions to Mixed Numbers and Mixed Numbers to Improper Fractions 219

4.1a Converting Improper Fractions to Mixed Numbers 219

4.1b Converting Mixed Numbers to Improper Fractions 221

4.2 Multiplication and Division of Mixed Numbers 225

4.3 Addition and Subtraction of Mixed Numbers 229

4.4 Applications 235

4.5 Complex Fractions 239

4.6 Order of Operations Applied to Mixed Numbers 245

Chapter Review 251

Chapter Test 1 253
Chapter Test 2 255

CHAPTER 5. **Decimals 257**
5.1 Place Value 257
Ordering Decimals 259
5.2 Rounding Decimals 265
5.3 Addition and Subtraction of Decimals 271
5.4 Multiplying Decimals 274
Multiplying Decimals by Powers of Ten 275
Exponents 278
5.5 Dividing Decimals 284
Dividing Decimals by Powers of Ten 287
5.6 Square Roots of Decimals 291
5.7 Order of Operations Applied to Decimals 294
5.8 Applications 298
Chapter Review 307
Chapter Test 1 309
Chapter Test 2 312

CHAPTER 6. **Conversions, Ratios, and Proportions 315**
6.1 Fraction and Decimal Conversions 315
Converting Decimals to Fractions 315
Converting Fractions to Decimals 316
Arithmetic Operations with Fractions 319
6.2 Rate and Ratio 325
6.3 Length, Distance, and Weight 331
6.4 Unit Pricing 337
6.5 Solving Equations by Division 341
6.6 Proportions 345
The Means and the Extremes 345
Applications 348
Chapter Review 355
Chapter Test 1 358
Chapter Test 2 360

CHAPTER 7. **Percents 363**
7.1 What are Percents? 363
Converting Percents to Fractions 363

Converting Percents to Decimals 365
Converting Decimals to Percents 366
Converting Fractions to Percents 368
7.2 Basic Percent Problems 375
7.3 Solving Percent Word Problems 385
Percent Increase/Percent Decrease 387
7.4 Applications 393
Sales Tax 393
Commission 394
Sales Discounts 395
Simple Interest 396
Chapter Review 405
Chapter Test 1 407
Chapter Test 2 410

CHAPTER 8. **Signed Numbers 413**
8.1 Multiplication and Division of Signed Numbers 413
Multiplication Rules 413
Division Rules 418
8.2 Addition and Subtraction of Signed Numbers 423
8.3 Applications 431
Chapter Review 435
Chapter Test 1 437
Chapter Test 2 439

CHAPTER 9. **Introduction to Geometry 441**
9.1 Perimeter and Area 441
Squares 441
Rectangles 442
Triangles 444
Other Geometric Shapes 448
9.2 Circles 453
Radius, Diameter, and Circumference 453
Area 455
9.3 Volume 459
Cubes 459
Rectangular Solids 459

此为试读,需要完整PDF请访问: www.ertongbook.com

9.4 Applications 463
Perimeter and Area Applications 463
Chapter Review 469
Chapter Test 1 473
Chapter Test 2 476

Index I-1

Solutions to Workbooks and Chapter Reviews S-1

Chapter 1. Addition and Subtraction of Whole Numbers

In math we use numbers the way a language uses an alphabet. In this chapter and the next, we'll work with whole numbers such as 4, 10, 29, and 386. We'll solve hundreds of problems, and the answer to each of them will be a whole number.

To be successful at mathematics, you need to be able to add, subtract, multiply and divide without using a calculator. So put away your calculator because you won't be using it even once during this course. Back in the good old days, which both authors are old enough to remember, there *were* no calculators. Believe it or not, almost everyone got pretty good at math. So why not you? Well, what are we waiting for? Put away that calculator and let's get started!

1.1 Place Value

Before we can perform any arithmetic operations or applications with whole numbers, we need to study the value of the numbers. To do this, we must learn the following place value table.

TABLE 1.1 PLACE VALUE: ONES TO MILLIONS

Millions Column	Hundred Thousands Column	Ten Thousands Column	Thousands Column	Hundreds Column	Tens Column	Ones Column
1,000,000	100,000	10,000	1,000	100	10	1

Example 1: **Let's use the place value table to determine the place value and the value of the digits in the number 2,791.**

SOLUTION:

There is a 1 in the ones' place, so it has a value of $1 \times 1 = 1.$

There is a 9 in the tens' place, so it has a value of $9 \times 10 = 90.$

There is a 7 in the hundreds' place, so it has a value of $7 \times 100 = 700.$

There is a 2 in the thousands' place, so it has a value of $2 \times 1{,}000 = 2{,}000.$

Example 2: **Now we'll use the place value table to determine the place value and the value of the digits in the number 2,849, and to write it in expanded form.**

SOLUTION:

9 is in the ones' place, so it has a value of $9 \times 1 = 9.$

4 is in the tens' place, so it has a value of $4 \times 10 = 40.$

8 is in the hundreds' place, so it has a value of $8 \times 100 = 800.$

2 is in the thousands' place, so it has a value of $2 \times 1{,}000 = 2{,}000.$

We can say that $2{,}849 = 2{,}000 + 800 + 40 + 9.$

When we write a number this way, it's called *expanded form.* When a number is in expanded form, it's easy to see the place value of each of its digits. Now it's your turn to try one.

Example 3: **Determine the place value and the value of the digits in the number 345,952, and then write it in expanded form.**

SOLUTION:

2 is in the ones' place, so it has a value of	2 x 1 = 2.
5 is in the tens' place, so it has a value of	5 x 10 = 50.
9 is in the hundreds' place, so it has a value of	9 x 100 = 900.
5 is in the thousands' place, so it has a value of	5 x 1,000 = 5,000.
4 is in the ten thousands' place, so it has a value of	4 x 10,000 = 40,000.
3 is in the hundred thousands' place, so it has a value of	3 x 100,00 = 300,000.

Expanded form: 345,952 = 300,000 + 40,000 + 5,000 + 900 + 50 + 2.

Example 4: **Determine the place value and the value of the digits of 1,234,567, and write it in expanded form.**

SOLUTION:

7 is in the ones' place, so it has a value of	7 x 1 = 7.
6 is in the tens' place, so it has a value of	6 x 10 = 60.
5 is in the hundreds' place, so it has a value of	5 x 100 = 500.
4 is in the thousands' place, so it has a value of	4 x 1,000 = 4,000.
3 is in the ten thousands' place, so it has a value of	3 x 10,000 = 30,000
2 is in the hundred thousands' place, so it has a value of	2 x 100,000 = 200,000.
1 is in the millions' place, so it has a value of	1 x 1,000,000 = 1,000,000.

Expanded form: 1,234,567 = 1,000,000 + 200,000 + 30,000 + 4,000 + 500 + 60 + 7.

Example 5: **Determine the place value and the value of the digits of 3,580, and write it in expanded form.**

SOLUTION:

0 is in the ones' place, so it has a value of	0 x 1 = 0.
8 is in the tens' place, so it has a value of	8 x 10 = 80.
5 is in the hundreds' place, so it has a value of	5 x 100 = 500.
3 is in the thousands' place, so it has a value of	3 x 1,000 = 3,000.

Expanded form: 3,580 = 3,000 + 500 + 80.

Example 6: **Determine the place value and the value of the digits, of 513,296 and write it in expanded form.**

SOLUTION:

6 is in the ones' place, so it has a value of	6 x 1 = 6.
9 is in the tens' place, so it has a value of	9 x 10 = 90.
2 is in the hundreds' place, so it has a value of	2 x 100 = 200.

3 is in the thousands' place, so it has a value of $3 \times 1{,}000 = 3{,}000$.

1 is in the ten thousands' place, so it has a value of $1 \times 10{,}000 = 10{,}000$.

5 is in the hundred thousands' place, so it has a value of $5 \times 100{,}000 = 500{,}000$.

Expanded form: $513{,}296 = 500{,}000 + 10{,}000 + 3{,}000 + 200 + 90 + 6$.

We would like to point out to you that the commas in the numbers separate out the "major groups": thousands, millions, billions, and so on. Within each "major group" you find a number between 0 and 1,000; therefore a comma is needed.

Problem Set:

State the place value of the 5 and the value of the 5 in each of the following.

1) 235 2) 356 3) 50,998 4) 185,934 5) 577

State the place value of the 7 in each of the following and write each number in expanded form.

6) 1,750 7) 96,047 8) 7,294,300 9) 275,300 10) 1,205,072

SOLUTIONS TO PROBLEM SET:

1)	ones' place	5
2)	tens' place	50
3)	ten thousands' place	50,000
4)	thousands' place	5,000
5)	hundreds' place	500
6)	hundreds' place	$1{,}750 = 1{,}000 + 700 + 50$
7)	ones' place	$96{,}047 = 90{,}000 + 6{,}000 + 40 + 7$
8)	millions' place	$7{,}294{,}300 = 7{,}000{,}000 + 200{,}000 + 90{,}000 + 4{,}000 + 300$
9)	ten thousands' place	$275{,}300 = 200{,}000 + 70{,}000 + 5{,}000 + 300$
10)	tens' place	$1{,}205{,}072 = 1{,}000{,}000 + 200{,}000 + 5{,}000 + 70 + 2$

Now that we know all about place value, let's practice reading the names for numbers in the following examples.

Example 7: **1,234,567**

Solution: This number is read: one million, two hundred thirty-four thousand, five hundred sixty-seven. Notice the word "and" is not used when reading this number. The word "and" is used only when there's a decimal point in the number. If you misread this number as, one million, two hundred thirty-four thousand, five hundred and sixty-seven it, would be written 1,234,500.67. Don't use the word "and" unless the number has a decimal point.

Example 8: **3,580**
Solution: This number is read: three thousand, five hundred eighty.

Example 9: **2,791**
Solution: This number is read: two thousand, seven hundred ninety-one.

Example 10: **54,670**
Solution: This number is read: fifty-four thousand, six hundred seventy.

Problem Set:

Write the following numbers in words.
1) 235 2) 356 3) 50,998 4) 185,934 5) 577

SOLUTIONS TO PROBLEM SET:

1) two hundred thirty-five 2) three hundred fifty-six

3) fifty thousand, nine hundred ninety-eight

4) one hundred eighty-five thousand, nine hundred thirty-four

5) five hundred seventy-seven

Now we'll do the opposite; we'll give you a number in words and ask you to write it with digits.

Example 11: **Write six hundred thirty using digits.**
SOLUTION: 630

Example 12: **Write six hundred three using digits.**
SOLUTION: 603

Example 13: **Write sixty thousand, three hundred thirty-three using digits.**
SOLUTION: 60,333

Example 14: **Write two million, three hundred forty thousand, six hundred five using digits.**
SOLUTION: 2,340,605

Problem Set:

Write the following numbers using digits.

1) Three hundred twenty-three 2) Two thousand three

3) Two thousand, three hundred four 4) Six hundred fifty-six thousand, twenty-six

SOLUTIONS TO PROBLEM SET:

1) 323 2) 2,003 3) 2,304 4) 656,026

1.1 Workbook

State the place value of the digit 6 in each of the following numbers, and then write each number in expanded form.

1) 63

2) 776

3) 1,689

4) 61,435

5) 600,980

6) 186

7) 26,897

8) 163,007

9) 506

10) 6,009,540

State the place value of the digit 3 in each of the following numbers, and then write each number in expanded form.

11) 300

12) 12,039

13) 3,721

14) 973

15) 30,721

16) 36,000,000

17) 3,946,125

18) 437,091

19) 930

20) 6,735,000

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