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Algebra I

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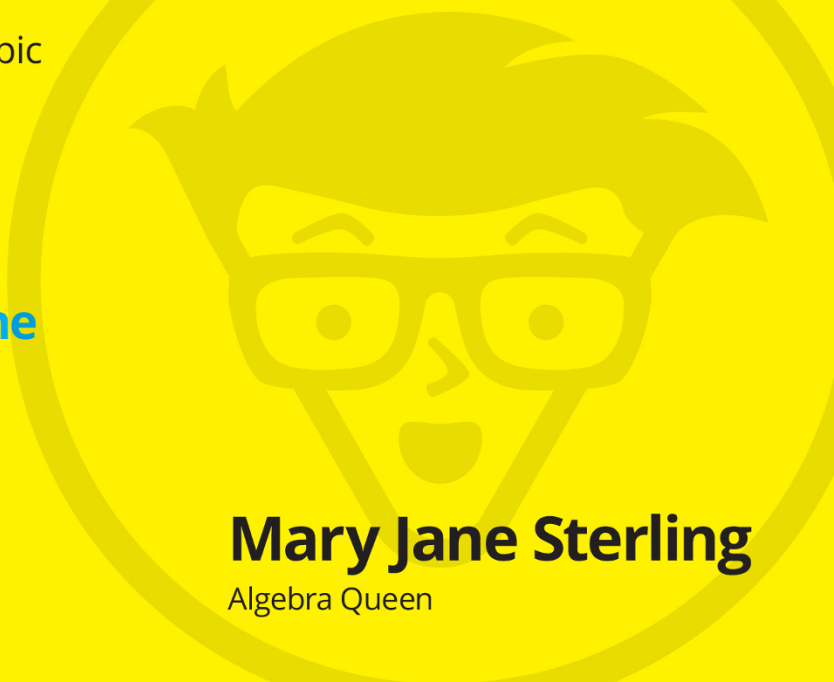

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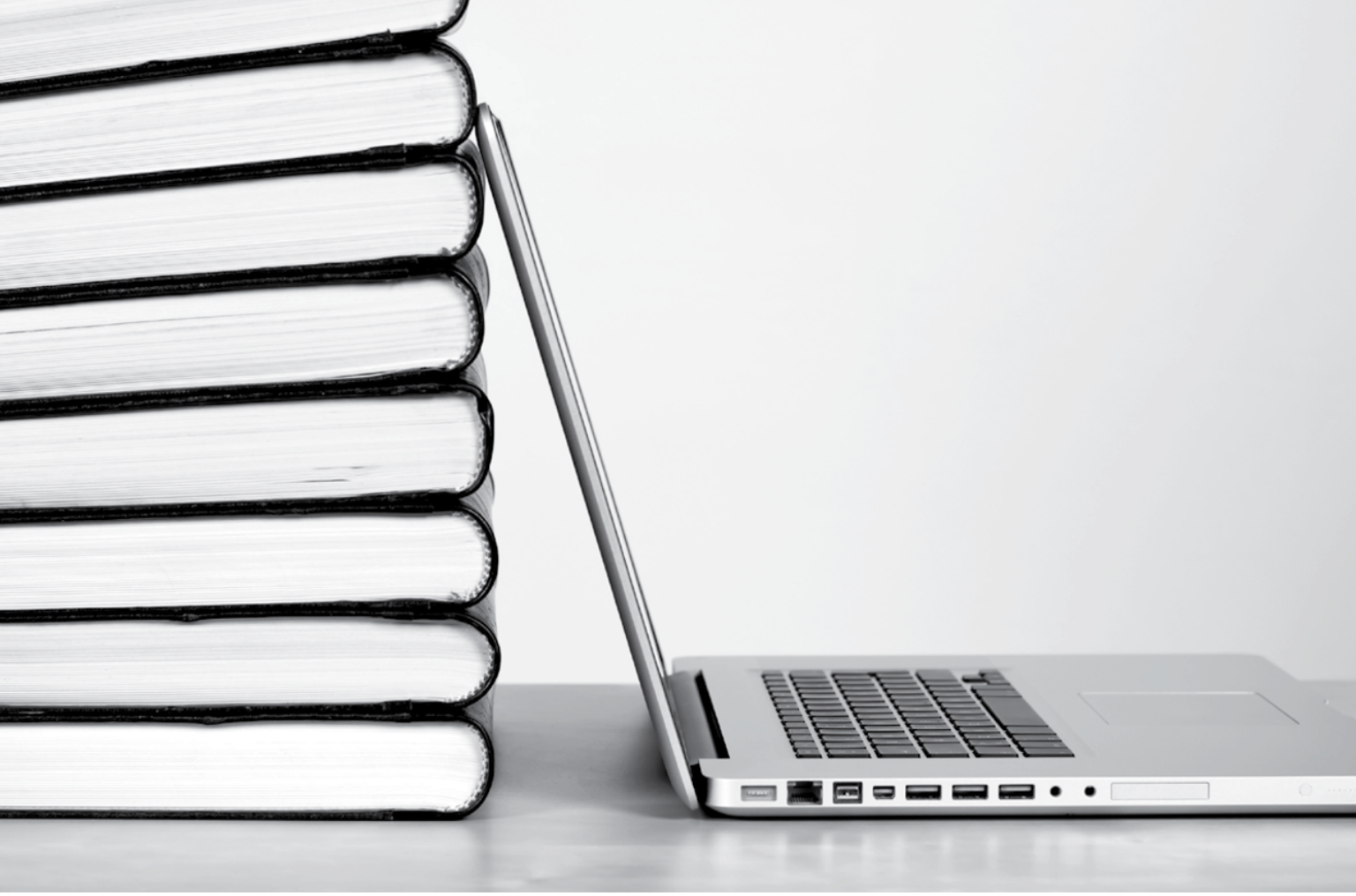
Mary Jane Sterling
Algebra Queen



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by Mary Jane Sterling

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Contents at a Glance

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Introduction

One-thousand-one algebra problems: That's a *lot* of algebra problems.

It will take you seven days to do all of them, if you do 143 each day. Whew! It will take you 91 days to do all of them, if you manage to do 11 each day. And, of course, it will take you 1,001 days to do all the problems if you do just one each day. Whatever your game plan, this is still a lot of problems. You may want to start at the beginning and do each problem in turn, or you may want to jump around and do the problems in an order that suits you best. Either plan is doable. Either plan is fine. Just watch out for topics that build on one another — you may need the information from one skill to succeed in another.

Practice makes perfect. Unlike other subjects where you can just read or listen and absorb the information sufficiently, mathematics takes practice. The only way to figure out how the different algebraic rules work and interact with one another is to get into the problems — get your hands dirty, so to speak. Many problems appear to be the same, on the surface, but different aspects and challenges have been inserted to make the different problems unique. The concepts become more set in your mind when you work with the problems and have the properties confirmed with your solutions.

Yes, one-thousand-one algebra problems are a lot of problems. But you may find that this just whets your appetite for more. Enjoy!

What You'll Find

This book has 1,001 algebra problems divided up among 23 chapters. Each chapter has many different sets of questions. The sets of questions are sometimes in a logical, sequential order, going from one part of a topic to the next and then to the next. Other times the sets of questions represent the different ways a topic can be presented. In any case, you're given instructions on doing the problems. And sometimes you're given a particular formula or format to use.

Instead of just having answers to each of the problems, you find a worked-out solution for each and every one. Flip to the back of the book for the step-by-step process needed to solve the problems. The solutions include verbal explanations inserted in the work where necessary. Sometimes an alternate procedure may be offered. Not everyone does algebra exactly the same way, but this book tries to provide the most understandable and success-promoting process to use when solving the algebra problems presented.

How This Workbook Is Organized

This workbook is divided into two main parts: questions and answers. But you probably figured that out already.

Part 1: Questions

The questions chapters cover many different topics:

- **Basic operations:** The first six chapters cover the types of numbers and the types of operations on those numbers that are essential to working in algebra. The natural numbers and whole numbers are fine for elementary arithmetic, but you need to broaden your horizons with signed numbers and decimals and fractions and exponential expressions. All these types of numbers are added, subtracted, multiplied, and divided. The rules for the different types of numbers have similarities and differences. The problems can help you come to grips with these situations and recognize what's the same and what's different.

  Also important in algebra are the operations involving radicals, absolute value, and factorial. And, tying together all the numbers and operations are the rules on how to deal with them: the order in which you perform the operations, and then the effect of grouping symbols on the whole process.

- **Algebraic expressions:** An algebraic expression can consist of one or more terms — separated by addition and subtraction — or it can be in factored form. The factored form has everything connected by multiplication and division. Each of these forms is useful in some process or another, so it's important to be able to change from one form to another and back again. Multiply out the factors if you want a listing of terms from highest exponent to lowest. Or, factor many terms to make them all just one if you want to solve for a root or reduce some fraction.

  You'll find techniques for multiplying by one term or two — or more. There are some helpful tricks for raising binomials to higher powers. And then you find the factoring techniques — from rules of divisibility to factoring by grouping. One of the challenges of factoring expressions is deciding which technique to use. You find lots of practice to help you make those decisions.

- **Solving equations:** What is the point of learning all those algebra basics and then going through the factoring process? One of the favorite and most common goals for all that practice is to use the techniques to solve an equation. Solving an equation means identifying the number or numbers you can replace the variable with to make a true statement.

  You'll find factoring and the multiplication property of zero to be your first approach, and then you'll also have the quadratic formula to use on some of the more challenging second-degree equations. Polynomials can be solved using synthetic division to help with the factoring. And then you have radical and absolute value equations — with their particular challenges. Finish the section off with inequalities, and you'll have run the gamut of solving for what variables can represent.

- **Applications:** Mention the words *story problem*, and you'll see either a shudder or a brightening smile. People either love them or they don't. But story problems (practical applications) are a main goal of learning to use algebra effectively.

The practical applications found in this section of the workbook are broken into many different types. You find some that are based on an established formula: area, perimeter, simple interest, and so on. Other applications have to do with relationships between numbers or sizes of objects. The trick to doing those applications is understanding the wording, which is why you come armed with all the basics under your belt. Get to work on the work problems before you age too much with the age problems. Just write yourself a simple algebraic equation, and you're almost finished.

- **Graphing:** Most of us are very visual — we understand things better when a picture is drawn. I usually draw pictures when working on word problems; it helps me focus on what type of equation to write. But the pictures in this section are a bit more structured. The pictures here involve the *Cartesian coordinate* system, which involves placing points, segments, and lines in their proper positions. Graphing lines is often used when solving systems of equations. And graphing is found in pretty much all the mathematics that follows algebra. This is where you can get a good start on the topic.

Part 2: Answers

This part provides not only the answers to all the questions but explanations of the answers as well. So you get the solution, and you see how to arrive at that solution.

Beyond the Book

In addition to what you're reading right now, this book comes with a free, access-anywhere Cheat Sheet that includes tips and other goodies you may want to have at your fingertips. To get this Cheat Sheet, simply go to `www.dummies.com` and type **Algebra I 1001 Dummies Cheat Sheet** into the Search box.

The online practice that comes free with this book offers you the same 1,001 questions and answers that are available here, presented in a multiple-choice format. The beauty of the online problems is that you can customize your online practice to focus on the topic areas that give you trouble. If you're short on time and want to maximize your study, you can specify the quantity of problems you want to practice, pick your topics, and go. You can practice a few hundred problems in one sitting or just a couple dozen, and whether you can focus on a few types of problems or a mix of several types. Regardless of the combination you create, the online program keeps track of the questions you get right and wrong so you can monitor your progress and spend time studying exactly what you need.

To gain access to the online practice, you simply have to register. Just follow these steps:

1. **Register your book or ebook at Dummies.com to get your PIN. Go to** `www.dummies.com/go/getaccess`.
2. **Select your product from the dropdown list on that page.**
3. **Follow the prompts to validate your product and then check your email for a confirmation message that includes your PIN and instructions for logging in.**

If you don't receive this email within two hours, please check your spam folder before contacting us through our Technical Support website at`http://support.wiley.com` or by phone at 877-762-2974.

Now you're ready to go! You can come back to the practice material as often as you want — simply log in with the username and password you created during your initial login. No need to enter the access code a second time.

Your registration is good for one year from the day you activate your PIN.

Where to Go for Additional Help

The written directions given with the individual problems are designed to tell you what you need to do to get the correct answer. Sometimes the directions may seem vague if you aren't familiar with the words or the context of the words. Go ahead and look at the solution to see if that helps you with the meaning. But if the vocabulary is still unrecognizable, you may want to refer to the glossary in an algebra book, such as *Algebra I For Dummies,* written by yours truly and published by the fine folks at Wiley.

The solution to each problem is given at the end of its respective chapter. But you may not be able to follow from one step to the next. Is something missing? This book is designed to provide you with enough practice to become very efficient in algebra, but it isn't intended to give the step-by-step explanation on how and why each step is necessary. You may need to refer to *Algebra I For Dummies* or *Algebra I Essentials For Dummies* (also written by me and published by Wiley) to get more background on a problem or to understand why a particular step is taken in the solution of the problem.

1 The Questions

IN THIS PART . . .

Performing basic operations (Chapters 1 through 6)

Changing the format of algebraic expressions (Chapters 7 through 12)

Solving equations (Chapters 13 through 17)

Applying algebra by using formulas and solving word problems (Chapters 18 through 20)

Graphing (Chapters 21 through 23)

Chapter 1

Signing on with Signed Numbers

Signed numbers include all real numbers, positive or negative, except 0. In other words, signed numbers are all numbers that have a positive or negative sign. You usually don't put a plus sign in front of a positive number, though, unless you're doing math problems. When you see the number 7, you just assume that it's +7. The number 0 is the only number that isn't either positive or negative and doesn't have a plus or minus sign in front of it; it's the dividing place between positive and negative numbers.

The Problems You'll Work On

As you work with signed numbers (and positive and negative values), here are the types of problems you'll do in this chapter:

- Placing numbers in their correct position on the number line — starting from smallest to largest as you move from left to right
- Performing the absolute value operation — determining the distance from the number to 0
- Adding signed numbers — finding the sum when the signs are the same and finding the difference when the signs are different
- Subtracting signed numbers — changing the second number to its opposite and then using the rules for addition
- Multiplying and dividing signed numbers — counting the number of negative signs and assigning a positive sign to the answer when an even number of negatives exist and a negative sign to the answer when an odd number of negatives exist

What to Watch Out For

Pay careful attention to the following items when working on the signed number problems in this chapter:

- Keeping track of the order of numbers when dealing with negative numbers and fractions

- Working from left to right when adding and subtracting more than two terms
- Determining the sign when multiplying and dividing signed numbers, being careful not to include numbers without signs when counting how many negatives are present
- Reducing fractions correctly and dividing only by common factors

Placing Real Numbers on the Number Line

1–6 *Determine the correct order of the numbers on the real number line.*

1. Determine the order of the numbers:

$-3, 4, -1, 0, -4$

2. Determine the order of the numbers:

$-3, 3, -2, 0, 1$

3. Determine the order of the numbers:

$-1, 2, -5, \frac{3}{7}, -\frac{7}{3}$

4. Determine the order of the numbers:

$\frac{5}{6}, -\frac{6}{5}, -2, -4, 0$

5. Determine the order of the numbers:

$\sqrt{3}, -\sqrt{2}, 0, 3, -4$

6. Determine the order of the numbers:

$-3, \sqrt{3}, 0, 2, 4, -\frac{7}{2}$

Using the Absolute Value Operation

7–10 *Evaluate each expression involving absolute value.*

7. $|-4|$

8. $|-7.6|$

9. $-|-2|$

10. $-\left|-\frac{2}{3}\right|$

Adding Signed Numbers

11–20 *Find the sum of the signed numbers.*

11. $-4+(-2)=$

12. $2+(-4)=$

13. $-2+4=$

14. $-5+3=$

15. $-6+6=$

16. $7+(-2)=$

17. $5+(-4)+(-2)=$

18. $-1+2+(-3)+4=$

19. $-67+68+(-69)+70=$

20. $-4+(-5)+(-6)+(-7)+7+4=$

Subtracting Signed Numbers

***21–30** Find the difference between the signed numbers.*

21. $-4-6=$

22. $7-(-8)=$

23. $6-3=$

24. $-9-(-4)=$

25. $-7-7=$

26. $-7-(-7)=$

27. $3-(-2)=$

28. $-[-2]-3=$

29. $-[-4]-(-4)=$

30. $0-(-5)=$

Multiplying and Dividing Signed Numbers

***31–50** Find the products and quotients involving signed numbers.*

31. $2(-3)=$

32. $-4(-5)=$

33. $-5(6)=$

34. $3(-1)=$

35. $(-7)(-7)=$

36. $(-8)(8)=$

37. $-6\left(-\frac{5}{3}\right)=$

38. $20\left(-\frac{3}{4}\right)=$

39. $-2(0)=$

40. $(-1)(-1)(-1)(-1)=$

41. $\frac{-6}{2}=$

42. $\frac{-8}{-4}=$

43. $\frac{12}{-3}=$

44. $\frac{-60}{-15}=$

45. $\frac{0}{-2} =$

46. $\frac{-5}{1} =$

47. $\frac{-16}{2(-4)} =$

48. $\frac{2(-6)(-1)}{4(-3)} =$

49. $\frac{-4(-3)(-2)(-1)}{6(-1)(-1)(-1)} =$

50. $\frac{2(2)(-3)(-3)}{(-2)(-2)(3)(3)} =$

Chapter 2

Recognizing Algebraic Properties and Notation

The properties used in mathematics were established hundreds of years ago. Mathematicians around the world wanted to be able to communicate with one another; more specifically, they wanted to get the same answers when working on the same questions. To help with that, they developed and adopted rules such as the commutative property of addition and multiplication, the associative property of addition and multiplication, and the distributive property.

The Problems You'll Work On

To strengthen your skills with algebraic properties and notation, you'll practice doing the following in this chapter:

- Using the distributive property of multiplication over addition and subtraction
- Paying attention to the order of operations
- Simplifying radicals and radical expressions
- Reassociating terms for easier computation
- Regrouping and commuting for ease and accuracy

What to Watch Out For

Here are a few things to keep in mind while you work in this chapter:

- Distributing a negative number over several terms and being sure to apply the negative sign to each term
- Recognizing the fraction line as a grouping symbol

- Performing the absolute value operation when it's used as a grouping symbol
- Applying the correct exponent when multiplying or dividing variables

Applying Traditional Grouping Symbols

51–58 *Simplify the expressions.*

51. $6-(5-3)=$

52. $(4-3)-5=$

53. $5[6+(3-5)]=$

54. $8\{3-[4+(5-6)]\}=$

55. $\frac{8-4}{2}=$

56. $\frac{12}{9-11}=$

57. $\frac{3-(6-2)}{7-8}=$

58. $\frac{(5-6)-(9-3)}{3-10}=$

Introducing Some Non-Traditional Grouping Symbols

59–64 *Simplify the expressions involving radicals and absolute value.*

59. $\sqrt{12-8}=$

60. $\frac{11-3}{\sqrt{9-5}}=$

61. $\frac{\sqrt{11-10}}{3-4}=$

62. $|5-6|-7=$

63. $5-|4-7|=$

64. $\frac{\sqrt{20-4}}{|9-11|}=$

Distributing Multiplication over Addition and Subtraction

65–72 *Perform the distributions over addition and subtraction.*

65. $2(7-y)=$

66. $-6(x+4)=$

67. $-3\left(x-\frac{1}{3}\right)=$

68. $\frac{3}{4}(8-16y)=$

69. $x(y-6)=$

70. $-4x(x-2y+3)=$

71. $12\left(\frac{1}{6}-\frac{2}{3}+\frac{3}{4}\right)=$

72. $-5\left(4x-\frac{2}{5}\right)=$

Associating Terms Differently with the Associative Property

73–78 *Use the associative property to simplify the expressions.*

73. $47+(-47+90)=$

74. $(-6+23)-23=$

75. $\frac{3}{5}\left(\frac{5}{3}\cdot 29\right)=$

76. $\left(811\cdot\frac{1}{15}\right)15=$

77. $(16+19)+(-19+4)=$

78. $(77-53.2)+53.2=$

Rearranging with the Commutative Property

79–84 *Use the commutative property to simplify the expressions.*

79. $-16+47+16=$

80. $\frac{3}{11}+\frac{4}{3}-\frac{3}{11}=$

81. $432+673-432=$

82. $\frac{31}{17}\left(-\frac{12}{13}\right)\left(\frac{17}{31}\right)=$

83. $\frac{1}{9}\cdot\frac{25}{11}\cdot 18=$

84. $-3+4+23+3-23=$

Applying More Than One Property to an Expression

85–90 *Simplify each expression using the commutative, associative, and distributive properties.*

85. $-32+4(8-x)=$

86. $-5(x-2)-10=$

87. $48\left(\frac{x}{6}+1\right)-8x=$

88. $-\frac{1}{4}(4x-20)-5=$

89. $-2(3+y)+3(y+2)=$

90. $\frac{1}{8}\cdot\frac{5}{4}\left(-\frac{8}{5}\right)=$