

ALGEBRA 1

$8x^2$
 $5x^2 + 7x + 1$
 $5x = 35$
 $3 \cdot 5 = 15$
 $-27 + 6 - 2$
 $2 + 2 = 4$
 $3 \cdot 5 = 15$
 $5x = 35$
 $[(6 + 2) - 4] \cdot 7$
 $4x^3 + 2x^2 + 7x + 1$
 $b^2 - 4ac$
 $7x + 6y = 42$
 $y = kx$
 $m = \frac{y_2 - y_1}{x_2 - x_1}$
 $y = mx + b$

Christian Light Education
 a division of Christian Light Publications, Inc.

a division of Christian Light Publications, Inc.

a division of Christian Light Publications, Inc.

Introduction

For Parents and Teachers

Algebra I teaches students basic algebra concepts. Its incremental approach of teaching concepts in small increments and use of continuous review makes Algebra I an effective math course. The consistent, systematic review helps students retain what they have learned. The goal is mastery, not just exposure.

How to use Algebra I

The text at the beginning of each lesson explains the new concept. Lessons also have examples that clearly describe each step used to complete the processes needed for the new concept.

Exercises are divided into 3 groups. The first and the last groups, titled “Today’s Lesson,” use the skill taught in the lesson. The second group makes up the majority of the exercises and reviews concepts taught in earlier lessons. Students should be able to work through these exercises independently. Small reference numbers after each direction line, and sometimes at individual exercises, indicate the previous lesson(s) where the concepts were taught. Review sections maybe further divided into skills, applications, and facts. Concepts are reviewed through the whole course or until they are absorbed into other skills.

Extra practice problems for the new concept are provided at the end of each lesson. These optional problems are for students who may need extra practice.

Lessons 5, 10, and 16 of each unit are quiz and test lessons. Lesson 15 is a review for the test. Material is reviewed a minimum of four times before it is quizzed or tested. The lessons on quiz and test days have an optional enrichment activity. The activities are not reviewed or tested.

The **appendix** includes the **glossary**, **index**, and **reference material**.

Course Materials

- **Algebra I textbook**
- **Student pack**
 - Quizzes
 - Tests
- **Full solution key**

Measurements



Section 1

1.1 Types of Numbers.....	2
1.2 Graphing Real Numbers; Absolute Values	5
1.3 Real Number Properties; Fractions.....	9
1.4 Adding and Subtracting Fractions.....	14
1.5 Quiz 1 ► How Wide is a Piece of Paper?	17

Section 2

1.6 Adding Positive and Negative Numbers	18
1.7 Multiplying and Dividing Fractions; Arithmetic with Decimals	22
1.8 Subtracting Positive and Negative Numbers	26
1.9 Variables, Constants, and Algebraic Expressions.....	29
1.10 Quiz 2 ► What's the Temperature?.....	32

Section 3

1.11 Applications of Positive and Negative Numbers	33
1.12 Multiplying Positive and Negative Numbers.....	39
1.13 Dividing Positive and Negative Numbers	43
1.14 Ratios and Percents	46
1.15 Review for Test.....	51
1.16 Test ► A Measure for Pleasure	53

Chinese Beginnings



Section 1

2.1 Exponents; Exponents and Negative Signs	56
2.2 Translating from Word Expressions to Math Expressions	60
2.3 Operations With Exponential Expressions	64
2.4 Order of Operations	68
2.5 Quiz 1 ► Marvelous Squares	72

Section 2

2.6 Using Parentheses to Translate from Word Expressions to Math Expressions	74
2.7 Combining Like Terms	78
2.8 Multiplying Terms	82
2.9 Dividing Terms	85
2.10 Quiz 2 ► Dürer's Beautiful Square	88

Section 3

2.11 The Distributive Property	89
2.12 Roots and Radicals	93
2.13 Recognizing and Representing Values Algebraically	97
2.14 Equations	100
2.15 Review for Test	105
2.16 Test ► The Game of Nim	107

Greek Discoveries



Section 1

3.1 The Distributive Property and Division	110
3.2 Mathematically Related Values	113
3.3 Solving More Complex Equations	116
3.4 Polynomials	120
3.5 Quiz 1 ► Prime Numbers	123

Section 2

3.6 Factors and Factoring	124
3.7 Adding Polynomials	127
3.8 Greatest Common Factor	130
3.9 Complex Relationships Between Values	133
3.10 Quiz 2 ► Perfect Numbers	136

Section 3

3.11 Solving Equations With Fractions or Decimals	137
3.12 Subtracting Polynomials	140
3.13 Factoring the Greatest Common Factor From a Polynomial	142
3.14 Simplifying Radicals	145
3.15 Review for Test	149
3.16 Test ► Tight Around the Middle	151

Michael Faraday



Section 1

4.1	Solving Literal Equations.....	154
4.2	Setting up Equations	157
4.3	Simplifying Radicals with Variables	160
4.4	Solving Two-Variable Equations.....	163
4.5	Quiz 1 ► How Do You Spell That Number?	166

Section 2

4.6	Multiplying Binomials	167
4.7	Graphing Ordered Pairs	170
4.8	Graphing Inequalities.....	174
4.9	Graphing Two-Variable (Linear) Equations	177
4.10	Quiz 2 ► Napier's Bones	181

Section 3

4.11	Graphing Compound Inequalities: Conjunctions and Disjunctions	182
4.12	Multiplying Larger Polynomials.....	186
4.13	Slopes of Linear Equation Graphs.....	189
4.14	Squaring Binomials.....	194
4.15	Review for Test	198
4.16	Test ► Infinity in a Box	200

Hindu & Arabic Concepts



Section 1

5.1 The Slope Formula	204
5.2 Establishing Equalities Using Geometry or Additional Quantities.....	207
5.3 Multiplying Radicals	211
5.4 Graphing From the Slope-Intercept Form	215
5.5 Quiz 1 ► A Poet's Version.....	219

Section 2

5.6 Mean, Median, and Mode	220
5.7 Solving Inequalities.....	223
5.8 Including the Value of Items in Equations	227
5.9 Simplifying Radicals with Numbers and Variables.....	231
5.10 Quiz 2 ► From Another Point of View.....	234

Section 3

5.11 Multiplying Sum and Difference Binomials	235
5.12 Writing the Equation of a Graph	238
5.13 Establishing Equalities for Rates and Mixtures	242
5.14 Factoring a Difference of Squares	246
5.15 Review for Test.....	249
5.16 Test ► A "Proof" That 2 Is Equal to 1.....	251

Music



Section 1

6.1	Graphing from the x - and y - intercepts	254
6.2	Factoring Perfect Square Trinomials	258
6.3	Systems of Linear Equations.....	261
6.4	Solving Systems of Equations by Substitution	265
6.5	Quiz 1 ► What Does it Look Like When Stars Sing?	270

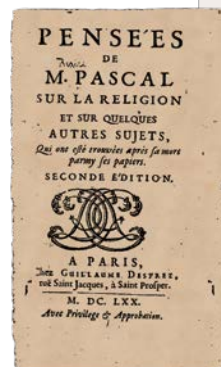
Section 2

6.6	Stem-and-leaf Plots	271
6.7	Factoring Trinomials in the Form $x^2 + bx + c$	275
6.8	Direct Variation: $y = kx$	279
6.9	Rational Expressions: Canceling Factors.....	283
6.10	Quiz 2 ► Turn Off That Noise!	286

Section 3

6.11	Solving Systems of Equations by Addition/Elimination	287
6.12	Reviewing Uses of the Negative Sign.....	291
6.13	Equalities Between Identical Formulas	295
6.14	Multiplying Rational Expressions	300
6.15	Review for Test	303
6.16	Test ► Fibonacci Numbers and Music.....	305

Blaise Pascal



Section 1

7.1 Solving Systems of Equations by Multiplication/Addition	308
7.2 Factoring by Grouping	313
7.3 Writing a Linear Equation From a Point and a Slope	317
7.4 Dividing Rational Expressions	320
7.5 Quiz 1 ► Pascal's Triangle	324

Section 2

7.6 Range and Standard Deviation	326
7.7 Factoring Trinomials in the Form $ax^2 + bx + c$	330
7.8 Adding and Subtracting Radicals	335
7.9 Writing a Linear Equation From Two Points	338
7.10 Quiz 2 ► Take a Seat	342

Section 3

7.11 Equalities Between Interest Applications	343
7.12 Graphing Linear Inequalities	347
7.13 Inverse Variation: $y = \frac{k}{x}$	352
7.14 Dividing a Trinomial by a Binomial	356
7.15 Review for Test	359
7.16 Test ► Only Pennies a Day!	361

Robert Boyle



Section 1

8.1 Factoring Completely	364
8.2 Writing Equivalent Rational Expressions.....	367
8.3 Adding and Subtracting Rationals With Common Denominators	371
8.4 Graphing Systems of Linear Inequalities.....	374
8.5 Quiz 1 ► Responding to Pressure	378

Section 2

8.6 Box-and-Whisker Plots and Outliers.....	379
8.7 Dividing Polynomials with Remainders.....	383
8.8 Lowest Common Denominator.....	387
8.9 Quadratic Equations: Solving by Factoring.....	391
8.10 Quiz 2 ► How'd He Do That?	395

Section 3

8.11 Rational Expressions: Excluded Values	396
8.12 Solving Applications by Using Systems of Equations.....	400
8.13 Functions	404
8.14 Dividing Larger Polynomials	408
8.15 Review for Test	411
8.16 Test ► Unavoidable Patterns.....	413

Isaac Newton



Section 1

9.1 Quadratic Equations: Taking the Square Root of Both Sides	416
9.2 Dividing Radicals	419
9.3 Adding and Subtracting Rationals With Unlike Denominators	423
9.4 Rationalizing Denominators	427
9.5 Quiz 1 ► Newton's Law of Gravity	430

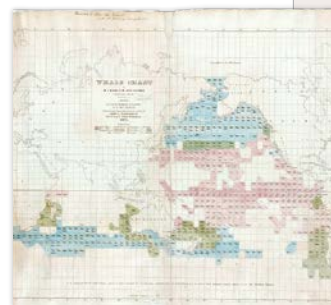
Section 2

9.6 Scatter Plots	431
9.7 Equations: Completing the Square	436
9.8 Dividing Polynomials With Missing Terms	440
9.9 Complex Rational Expressions	443
9.10 Quiz 2 ► In Perfect Balance	448

Section 3

9.11 Quadratic Equations: Solving by Completing the Square	449
9.12 The Domain of a Function	453
9.13 Solving Rational Expressions	457
9.14 Quadratic Equations: The Quadratic Formula	462
9.15 Review for Test	465
9.16 Test ► Under the Arch	467

Matthew Maury



Section 1

10.1	Fractional Exponents	470
10.2	Absolute Value Equations	473
10.3	Canceling in Unit Conversion	477
10.4	Graphing Absolute Value Inequalities	481
10.5	Quiz 1 ► Paths in the Seas	485

Section 2

10.6	Best Fit Lines and Extrapolation	486
10.7	The Discriminant of a Quadratic Equation	493
10.8	Multiplying and Dividing With Fractional Exponents	496
10.9	Longer Unit Conversions	499
10.10	Quiz 2 ► Just One More Foot, Please	503

Section 3

10.11	Probability	504
10.12	Applications Using Inequalities	507
10.13	Function Notation	511
10.14	Graphing a System With an Equation and an Inequality	514
10.15	Review for Test	517
10.16	Test ► Cartography: Four-Color Maps	519
	Glossary	520
	Index	522
	Acknowledgments and Credits	526
	Reference	528

Solving More Complex Equations

So far, you have solved equations with variables on only one side of the equation. However, equations often have variables on both sides, such as the equation $2x + 6 = x - 1$.

To solve equations with variables on both sides, simplify both sides of the equation first and then eliminate the variable from one side of the equation using the addition or subtraction property of equality. Then, with the variable on only one side, solve the equation using standard methods.

Each step is
clearly explained
in the examples.

Example 1 Solve the equation: $4x - 16 = x - 7$.

$$4x - 16 = x - 7 \quad \text{Original equation.}$$

$$\begin{array}{rcl} 4x - 16 & = & x - 7 \\ -x & & -x \end{array} \quad \begin{array}{l} x \text{ subtracted from both sides to eliminate the} \\ \text{variable from the right side.} \end{array}$$

$$3x - 16 = -7 \quad \text{Simplified.}$$

$$\begin{array}{rcl} 3x - 16 & = & -7 \\ +16 & & +16 \end{array} \quad \begin{array}{l} 16 \text{ added to both sides to eliminate the constant} \\ \text{from the variable side.} \end{array}$$

$$3x = 9 \quad \text{Simplified.}$$

$$\frac{3x}{3} = \frac{9}{3} \quad \begin{array}{l} \text{Both sides divided by 3 to change the coefficient} \\ \text{of the variable to 1.} \end{array}$$

$$x = 3 \quad \text{Simplified.}$$

Check:

$$4(3) - 16 = 3 - 7 \quad \begin{array}{l} 3 \text{ substituted for } x \text{ in the original equation.} \end{array}$$

$$-4 = -4 \quad \begin{array}{l} \text{Simplified. Because this statement is true, the} \\ \text{answer to the equation is correct.} \end{array}$$

It does not matter from which side the variable is eliminated. However, eliminating the variable with the smaller coefficient gives a positive variable, which is usually preferred.

Some people prefer to solve equations with the variable on the left, which sometimes results in a negative variable. Multiplying or dividing each side by -1 will make the variable positive and show the correct solution.

Examples 2a and 2b on the next page show an equation being solved with the variable positive and then negative. The answer is the same regardless of how it is solved.



Math in History

A story is told that when Thales' mule came to a stream, it learned to roll over to dissolve the salt in its load and make it lighter. Thales cured the mule of the bad habit by replacing the salt with sponges.

The solution key will always show the final solution with the variable on the left, even when solved with a positive variable on the right.

Notes in the margin provide important tips.



Math in History

Thales used calculations based on similar triangles to figure the heights of the pyramids at Giza, Egypt.

Example 2a Solve the equation: $3(4 - 2x) = -5x - 10$.

$3(4 - 2x) = -5x - 10$	Original equation.
$12 - 6x = -5x - 10$	Simplified using the distributive property.
$12 - 6x = -5x - 10$ $+6x \quad +6x$	$6x$ added to both sides to eliminate the variable with the smaller coefficient.
$12 = x - 10$	Simplified.
$12 = x - 10$ $+10 \quad +10$	10 added to both sides to eliminate it from the variable side.
$22 = x$	Simplified.
$x = 22$	Solution reversed to show variable on left.
Check:	
$3[4 - 2(22)] = -5(22) - 10$	22 substituted for x in the original equation.
$-120 = -120$	Check.

Example 2b shows the problem solved with variable on the left and negative variable changed to a positive variable by dividing each side by -1 .

Example 2b Solve the equation: $3(4 - 2x) = -5x - 10$.

$3(4 - 2x) = -5x - 10$	Original equation.
$12 - 6x = -5x - 10$	Simplified using the distributive property.
$12 - 6x = -5x - 10$ $+5x \quad +5x$	$5x$ added to both sides to eliminate the variable from the right side.
$12 - x = -10$	Simplified.
$12 - x = -10$ $-12 \quad -12$	12 subtracted from both sides to eliminate it from the variable side.
$-x = -22$	Simplified.
$\frac{-x}{-1} = \frac{-22}{-1}$	Both sides divided by -1 to change the coefficient of the variable to 1 .
$x = 22$	Simplified.
Check:	
$3[4 - 2(22)] = -5(22) - 10$	22 substituted for x in the original equation.
$-120 = -120$	Check.

Today's Lesson

Solve.

1. $7x + 15 = 3x + 23$
2. $-6x - 9 = -11 - 8x$
3. $x - 10 = 11 - 2x$
4. $-8x + 23 = -5x + 11$
5. $2(5x - 3) + 2 = 7x - 5$
6. $6(2x - 1) - 4x = 2$

Exercises are arranged with new material first, then review of previous material. At the end of each lesson the student works with the new material again and has the option of extra practice if needed.

REVIEW

Label and represent the value(s) algebraically. 3.2

7. The larger of two numbers is five times the smaller number.
8. A 60-inch board is cut into two unequal pieces.
9. Rachel made twice as many chocolate chip cookies as peanut butter cookies.
10. Brooke worked 5 less hours at the coffee shop than LeAnn.

Skills



Evaluate. 1.2

11. $2 \cdot |-7 - 4| \cdot |2|$
12. $17 - |12 \div 4 + |-2||$
13. $|-4 \cdot 6| \div (-3) + 2$

Evaluate. 2.1, 2.3

14. 6^1
15. 7^0
16. $(-2)^4$
17. -3^2

Multiply or divide. 1.12, 1.13

18. $22 \div (-11)$
19. $5 \cdot (-4) \cdot (-3)$
20. $-6 \cdot (-3) \cdot (-2)$
21. $\frac{-8}{-2}$
22. $\frac{-12}{3}$
23. $\frac{24}{-8}$

Distribute the division and simplify. 3.1

24. $(3x + 3) \div 3$
25. $(18x^4y + 20x^3y^2) \div 2x^2y$
26. $(6y - 3) \div 3y$

Evaluate the expressions if $x = 2$, $y = 3$, and $z = 4$. 1.9

27. $\frac{yz}{x}$
28. $(xyz) \div (xy) \cdot y^2$
29. $x^2 + |-xy| \cdot yz$

Simplify. 2.11

30. $3x(2x^2 - 7)$
31. $6x^2(2x^2 + 3x - 4)$

Multiply or divide. 1.7

32. $\frac{5}{21} \cdot 7$
33. $7\frac{1}{2} \div \frac{2}{3}$
34. $\frac{11}{16} \cdot \frac{9}{22} \cdot \frac{8}{15}$

Application Write the answer.



35. On the school field trip there were 75 students and 5 teachers. In lowest terms, what was the student to teacher ratio? 1.14
36. Twenty-four students went on a field trip. Four adults went along as chaperones. Form a ratio and simplify it to show the amount of students per chaperone. 1.14
37. What is 40% of 1,280? 1.14
38. The freezing point of grain alcohol (ethanol) is -114°C (-173°F). The boiling point is 79°C (174°F). How much warmer is the boiling point than the freezing point? 1.14
39. In A.D. 44, Herod (Agrippa I), grandson of Herod the Great, mentioned in Acts 12, was eaten by worms and died. He was born in 10 B.C. How old was he when he died? 1.11

Small gray reference numbers give the lesson number where the concept was taught.

Assign variables(s) to the unknown(s), then translate the expression. 2.13

40. mother's age 10 years ago
41. the length is twice the width

Facts



Write the word(s) for each definition.

42. the number above the radical sign that indicates the root called for 2.12
43. the number under the radical sign for which the root is found 2.12

Today's Lesson

Solve.

44. $12x - 7 + x = -3 + x$
45. $-4x + 8 + 2x = 32 - 5x$
46. $-3(x + 1) - 2 = 23 + x$

Extra Practice

Solve.

47. $7x + 22 = -11 - 4x$
48. $-18x + 13 = -x - 4$
49. $11x - 1 = 5x + 5$
50. $2x - 7 = 20 - 9 - x$
51. $7(2x - 3) + 18x + 16 = 27$
52. $3(5x - 2) - 8x = 22$

Writing a Linear Equation From Two Points

In Lesson 7.3, linear equations were found using the slope and an ordered pair. The equation of a line can also be determined if two ordered pairs are known. These two ordered pairs can be used to find the slope. Then, as taught in Lesson 7.3, substitute the slope and the points from one of the ordered pairs into the slope-intercept equation to find the value of b . Using the value of b and the slope, a linear equation in slope-intercept form can be written.

Example 1 Write the equation for the line containing the points (1, 6) and (3, 2).

Step 1. Find the slope.

x_1 y_1 x_2 y_2 (x_1, y_1) and (x_2, y_2) paired with the two ordered pairs.
 (1, 6) (3, 2)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 6}{3 - 1}$ Corresponding values substituted into the slope formula.

$m = \frac{-4}{2} = -2$ Subtraction completed and ratio reduced; the slope is -2 .

Step 2. Find the b -value.

$y = mx + b$ Slope-intercept formula.

$6 = -2(1) + b$ Slope and one of the ordered-pair values (1, 6) substituted into the slope-intercept formula and the formula solved for b .

$8 = b$

Step 3. Write a linear equation.

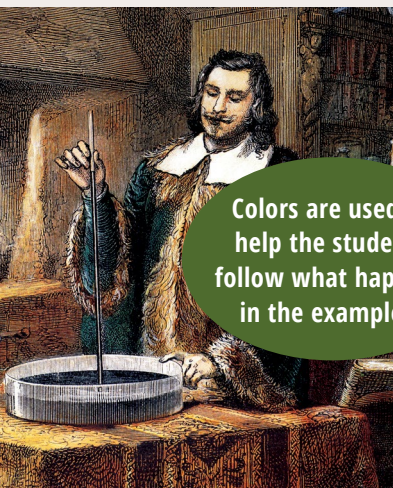
$y = -2x + 8$ Slope and b -value used to write an equation in slope-intercept form.

Steps Writing an Equation for a Line From Two Points

1. Determine the slope of the line by substituting the two ordered-pair values into the slope formula:

$$m = \frac{y_2 - y_1}{x_2 - x_1}.$$

2. Substitute this slope value and one of the ordered pairs into the slope-intercept equation and solve for b .
3. Using the slope and b -value from steps 1 and 2, write a linear equation in slope-intercept form.



Colors are used to help the students follow what happens in the examples.

Math in History

Evangelista Torricelli discovered the barometer while attempting to solve a problem that pump makers had trying to raise water to a height of 12 meters. Pascal used the barometer in his study of atmospheric pressure.

A summary box lists the steps involved in using a concept.



Math in History

Pascal used his brother-in-law Périer to assist him in his experiments with air pressure. Périer, who lived near the Puy de Dôme Mountain, measured the air pressure at the top of the mountain and at the bottom. He found that the air pressure was lower at the top of the mountain.

Example 2 Write the equation for the line containing the points $(-7, 2)$ and $(-3, 8)$.

Step 1. Find the slope.

$\begin{matrix} x_1 & y_1 & x_2 & y_2 \\ (-7, 2) & (-3, 8) \end{matrix}$ (x_1, y_1) and (x_2, y_2) paired with the ordered-pairs points.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 2}{-3 - (-7)}$ Corresponding values substituted into the slope formula.

$m = \frac{6}{4} = \frac{3}{2}$ Arithmetic simplified. The slope is $\frac{3}{2}$.

Step 2. Find the b -value.

$y = mx + b$ Slope-intercept formula.

$8 = \frac{3}{2}(-3) + b$ Slope and one of the ordered-pair values $(-3, 8)$ substituted into the slope-intercept formula and the formula solved for b . 8 is converted to the equivalent fraction of $\frac{16}{2}$.

$$8 = -\frac{9}{2} + b$$

$$\frac{16}{2} = -\frac{9}{2} + b$$

$$+\frac{9}{2} \quad +\frac{9}{2}$$

$$\frac{25}{2} = b$$

Step 3. Write a linear equation.

$y = \frac{3}{2}x + \frac{25}{2}$ Slope and b -value used to write an equation in slope-intercept form.

Today's Lesson

Write equations for the lines passing through these points.

1. $(1, 5), (3, 11)$

2. $(-2, -3), (-1, 2)$

3. $(3, -3), (9, -5)$

4. $(-4, 2), (-2, -1)$

REVIEW

Combine like radicals. If they cannot be combined, write *cannot be combined*. 7.8

5. $3\sqrt{x-1} + 2\sqrt{x-1}$

6. $5\sqrt{2} + 3\sqrt[3]{2}$

7. $(x-1)\sqrt{2} + 3\sqrt{2}$

8. $6\sqrt{7} - 8\sqrt{7}$