

WELCOME TO ALGEBRA 1!

"It was interesting to think that the very first liquid ever poured on the moon, and the first food eaten there, were communion elements."

— Buzz Aldrin

In July 1969, Apollo 11 became the first spaceflight to land human beings on the moon. Edwin "Buzz" Aldrin, pilot of the Lunar Module Eagle, marked the occasion by reciting John 15:5 and partaking in the Lord's Supper. As he recalled the atoning death of the one who created the very moon on which the Eagle sat, Aldrin hoped taking communion could symbolize "the thought that God was revealing Himself there too, as man reached out into the universe."

To make this moment happen, the entire Apollo 11 team relied upon the consistency and logical order within mathematics. Math, including algebra, is used extensively by spaceflight teams to calculate every detail for a mission, including supply needs, trajectories, and air pressure changes inside spacecraft.

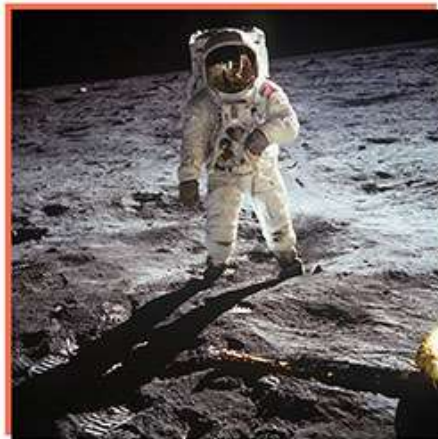
As you make your own voyage through *ALGEBRA 1*, you will consider God's grand design of an orderly universe and develop a biblical worldview of math itself: why it works, why it is an effective tool, and how it should be used. Each chapter focuses on one of five themes to help you form this biblical view: foundations, modeling, reasoning, design, and ethics.

What sort of math will you be learning? *Algebra* is taken from the Arabic word *al-jabr*, which carries the idea of the reunion or restoration of broken parts. The concepts and skills you will learn from this book will help you take the fragmented information of a problem (unknown quantities) and organize it into a useful mathematical form by manipulating numbers and variables. You will be challenged to develop skill in the following essential mathematical practices.

- MP1.** Persevere in problem solving.
- MP2.** Use abstract reasoning.
- MP3.** Construct logical arguments.
- MP4.** Use mathematical models.
- MP5.** Use appropriate tools.
- MP6.** Use precise language.
- MP7.** See and apply structure.
- MP8.** Generalize patterns.

This text provides instruction and exercises created to assist you in developing these skills. Each section comes with clearly stated learning targets, step-by-step examples, Skill Checks, QR codes for tutorial videos, and cumulative review. *ALGEBRA 1* has been written and designed with student success in mind.

Enjoy making the most of this year as you learn algebra. The problem-solving skills you develop will be useful to you whether you go on to be an entrepreneur, an architect, or even an astronaut. Shoot for the moon!



USING YOUR BOOK

CHAPTER 03 SOLVING INEQUALITIES

Chapter Introduction

Preview the basic outline of the chapter.

CHAPTER OVERVIEW

- 3.1 Single Inequalities
- 3.2 Multiple Inequalities
- 3.3 Conjunctions
- 3.4 Disjunctions
- 3.5 Absolute Value Equations

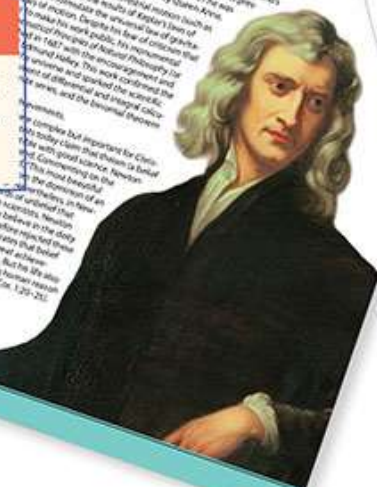
- 3.6 Absolute Value Inequalities
- Technology Corner—Graphing Inequality Solutions
- Application Problems—Calculating Interest
- Chapter 3 Review

MATH IN HISTORY

ISAAC NEWTON (1642-1727)

Math in History & Careers in Math

Read biblical perspectives on the lives of famous mathematicians and math-related careers.



CAREERS IN MATH

ACTUARY

The actuarial profession has been consistently rated as one of the best careers in the United States. Many colleges and universities offer an actuarial science major in their math departments. An actuary evaluates the likelihood of future events and works to mitigate the impact of undesirable events that occur in our future world. Most actuaries are employed by insurance companies to determine risk and set premiums for their job responsibilities as often much higher than that. An actuary deals with risk management, especially as it impacts the financial well-being of a business. Actuaries help companies build strategies to improve financial security as they navigate turbulent markets and interest rates. Some actuaries work in the field of consulting and financial services, while others work in the field of government and business. An actuary determines the likelihood of an uncertain event, such as the probability that a thirty-year-old man will live to be sixty-five. James Hervey, a Christian of the uncertainty of future events and instructs even businessmen to submit to whatever God wills (James 4:13-15). Nevertheless, the Bible teaches that the way of wisdom is to make wise decisions for the future (Provs 22:3, 27:12). Government and insurance industry opportunities for actuaries are widely abundant and are predicted to increase. In addition to working with insurance plans, actuaries, and social welfare programs, actuaries work to design creative ways to reduce the financial impact of undesirable events occurring. Christian actuaries can glorify God by using their God-given talents to anticipate and plan for the difficult circumstances that may occur in the lives of others.



TECHNOLOGY CORNER (TI-84 PLUS FAMILY)

Checking Polynomial Products

The graphing calculator can be used to check the results of multiplying a polynomial expression. Use Y_1 to enter the polynomial expression ($x^2 - 3x + 2$) as Y_1 . Graph the function using the standard screen from the ZOOM screen.

Then use Y_2 to enter a possible answer, $x^2 + 2x^2 - x + 2$ as Y_2 . Move the cursor onto the 1 key to the left of Y_2 , press DEL , and use the arrow keys to select the 4 key. Select GDBL .

Be sure MODE is selected in the MODE screen and select ZOOM to show the graphs of Y_1 and Y_2 . If the polynomials are equal, the graphs will coincide. The effect of selecting the 4 key below Y_2 shows that the expressions cannot be equal since their graphs do not coincide.

Be certain the product and add Y_2 to match the same answer, $x^2 + 2x^2 - x + 2$. It appears that the graphs coincide and that the expressions are equal.

Technology Corner

Follow step-by-step instructions to apply basic uses of the graphing calculator related to each chapter's content.

APPLICATION PROBLEMS
CALCULATING INTEREST

The shareholders of the First National Bank of New York have a vested interest in the financial health of the bank president, Mr. Lee, because that he must give them the bank's earnings. Mr. Lee knows that he must give the shareholders as high a rate for investing their money as he can manage to obtain. He needs to know how much money he must invest in municipal bonds that yield 6% the coming year. He must know the total amount he will have at least an additional 32.1 months.

The table has much to say about the way to do this. It includes each change in a person's net worth (from -2.7) as long as a person is holding his or her money. For this reason, a business should be very careful about borrowing money.

One way to prepare is to know about different types of loans. There are four as discussed below. Recall the interest formula $I = Prt$.

1. **Simple interest loans.** A single payment of interest and principal combined at the end of the term.
2. **Add-on loans.** Simple interest plus principal divided by the number of payments (usually monthly). Each payment applies the same amount to the principal and the same amount to interest.
3. **Discount loans.** The interest is calculated and added to the amount that is borrowed at the beginning of the loan. This one interest amount is divided into equal payments throughout the life of the loan.

Compare these types of loans for \$1000 borrowed at 6% interest for 3 yr in the ways described above.

1. **Simple interest loan.** Find the amount of interest earned and the entire amount due at the end of the loan.
2. **Add-on loan.** Find the amount of interest, the total amount to repay, and the monthly payment.
3. **Discount loan.** Calculate the actual amount loaned for the borrower for money \$1000 using the formula $S = \frac{P}{1 + i}$, where S is the amount that must be borrowed, P is the amount the borrower receives, i is the interest rate, and t is the time in years. Then find the amount of interest and the monthly payment.

If money must be borrowed, it is wise to find the best rate. Interest rates are expressed in a more standard percentage rate (APR) and annual percentage yield (APY). The APR expresses annual interest without considering compound interest. The APY expresses annual interest, including compound interest earned on both principal and previous interest. When the lender receives monthly payments, the APR on the remaining principal throughout the term of a loan, the actual interest rate is not equal to the simple interest rate (APR). Calculating the APY reveals that borrowers are actually paying a higher rate than the APR.

$$APY = (1 + \frac{APR}{n})^n - 1$$
, where n is the number of compounding periods per year.

Find the APY of a 3 yr \$1000 loan with a 7% compounded monthly.

$$\text{Using } n = 12, APY = (1 + \frac{0.07}{12})^{12} - 1 = 1.07229 - 1 = 0.07229$$
 or about 7.229%.

The actual interest rate is about 7.229%, which is more than the 7% APR.

To provide protection for borrowers, the Federal Reserve Board requires lenders to disclose a discount factor (APY) and the annual percentage rate (APR) percentage (with APR).

Remember monthly payments. The APR is the rate on the remaining balance, based on the following loans, based on the same terms.

4. Mr. Eileen was quoted an interest rate of 7% APR for a loan to expand his business.

Application Problems

Apply learned math skills to solve real-world problems.

STEM PROJECT
THE WATER WHEEL

Design a water wheel to generate power. The water wheel is a device that converts the energy of flowing water into mechanical energy. The water wheel is a device that converts the energy of flowing water into mechanical energy. The water wheel is a device that converts the energy of flowing water into mechanical energy.

STEM Project

Preview the semester STEM projects located in Activities.

Essential Question & Learning Targets

Start each section with a question about the key idea and a list of the skills you should expect to learn.

3.4 DISJUNCTIONS

What is the difference between the disjunction and conjunction of the graphs of 2 inequality statements?



After completing this section, I will be able to:

- define a disjunction
- write disjunctions
- write disjunctions that are not disjunctions

DEFINITION
A disjunction is a compound sentence consisting of mathematical statements connected by the word or.

The relation to a disjunction will consist of any value that is part of the solution set to either inequality and can be written as a statement using the word or. The graph of the solution consists of the union of the graphs of the inequalities.

EXAMPLE 1: Graphing a Disjunction
Graph the solution set of $3x + 12 < x + 6$ or $x + 3 > 6$.

Answers:

- Solve each inequality separately.
- Graph each inequality above the number line.
- Identify the union of the 2 graphs and graph it on the number line.
- Write the solution for the union.

Key Concepts

Read through explanations of key concepts and remember important ideas highlighted within margin boxes.

RECALL
If the set of integers

EXAMPLE 1: Graphing a Relation
Graph the relation $y = 3x + 1$ for $x = 0, 1, 2, 3, 4, 5$. State whether the relation is a function.

Answers:

- If a set of ordered pairs (x, y) such that x and y are integers from 1 to 5 including 1 and 5 is plotted to 5.
- Order the set from $(0, 1), (1, 4), (2, 7), (3, 10), (4, 13), (5, 16)$.
- Graph the relation.
- No vertical line can be drawn that passes through more than 1 point.

The relation is a function.

Without the restriction of the domain to integral values in the previous example, the graph would contain all possible real values of x from 1 to 5. The small \square in the segment from $(0, 1)$ to $(5, 16)$ shows that points such as $(2.1, 7.3)$ and $(4.5, 15)$ are members of this relation. The vertical line test indicates that this is the graph of a function.

Relations can often be described in terms of equations or inequalities.

EXAMPLE 2: Graphing a Relation
Graph $D = \{(x, y) \mid y = 2x^2, x = 1, 4, 6\}$. State its domain and range.

Answers:

- Make a table to find the ordered pairs. Substitute the x -values from the domain into the equation $y = 2x^2$. Each value of x produces 1 value for y .
- Graph the set of ordered pairs: $(1, 2), (4, 32), (6, 72)$.
- The domain is the given set of x -coordinates. The range is the set of y -coordinates.
- The relation fails the vertical line test; each value of x represents 1 value for y .

DEFINITION
A relation is not a function.

If the domain consists of integer values of x , then the graph of the graph can be sketched by plotting a sufficient number of points. These points can be connected by a smooth curve to complete the graph.

QR CODES
Scan the QR code to access additional resources.

82 GRAPHING RELATIONS AND FUNCTIONS

RECALL
Repeat the distributive property for the distributive property

EXAMPLE 2: Removing Parentheses before Solving
Solve for x : $3(x - 2) = 15$.

Answers:

- Remove parentheses by applying the Distributive Property.
- Combine like terms.
- Subtract 6 from both sides.
- Divide both sides by 3.
- Check.

The properties of equality can be used to convert a repeating decimal to a fraction.

CONVERTING REPEATING DECIMALS TO FRACTIONS

- Write an equation in which x equals the repeating decimal.
- Use the Multiplication Property of Equality to multiply both sides of the equation by 10^n , where n is the number of repeating digits.
- Apply the Subtraction Property of Equality to subtract equivalent quantities from both sides of the equation.
- Solve the resulting equation and reduce the fraction to lowest terms.

EXAMPLE 3: Converting a Repeating Decimal to a Fraction
Express each decimal as a quotient of integers.

Answers:

- $0.\overline{30}$
- $1.\overline{25}$
- $x = 0.\overline{30}$
- $100x = 30.\overline{30}$
- $-x = 0.\overline{30}$
- $99x = 30$
- $x = \frac{30}{99}$
- Reduce the fraction.
- Let x equal the repeating decimal.
- Multiply both sides of the equation by $10^n = 100$ (where the decimal to the right of the bar is 100 times the decimal to the left of the bar). Then apply the Subtraction Property of Equality.
- Solve the resulting equation. Clear the decimal from the fraction by multiplying the numerator and denominator by 10.
- Use a calculator to verify your solution.

This procedure can be used to convert any repeating decimal to an equivalent quotient of integers and denominators that are integers.

83 CONVERTING DECIMALS

QR Codes

Link to valuable tutorial content located on AfterSchoolHelp.com.

Examples & Skill Checks

Study the step-by-step reasoning in solving example problems, and check your understanding by completing targeted exercises mapped to each example.

Exercises

Build and maintain your skills with carefully sequenced exercises that emphasize the essential question and essential mathematical practices (MPs).

Mind over Math

Challenge your critical thinking with this unique feature found in each chapter.

Cumulative Review

Systematically review key concepts and practice strategies for standardized testing.

The diagram to the right illustrates an inscribed cylinder. Let V represent the volume of the inscribed region between the lower and outer cylinders. **41.** Write an equation modeling the volume of the inscribed region. Then factor the right-hand side of the resulting equation. **42.** If the height of the cylinder is 12 in, with an outer radius of 3 in between the 2 cylinders in terms of r .

CUMULATIVE REVIEW

Use the mapping diagram for exercises 43–47. (4.1)

43. State the domain of the relation.

44. State the range of the relation.

45. Is the relation a function?

46. Write the relation as a set of ordered pairs.

47. If (x, y) was included in the relation, for what value(s) of x would the relation not be a function?

Multiply. (1.6)

48. $(r - 3)(r + 4)$

49. $4x(x + 1)$

50. $6y(x + 1)(x - 4)$

51. Which function models a yearly 10% depreciation of a car originally valued at \$15,000? (2.8)

52. Find the quotient of $2x^2 - 22x + 13$ and $x - 1$. (R.2)

53. Find the quotient of $3x^2 - 22x + 13$ and $x - 1$. (R.2)

54. $3x^2 - 22x + 13$

55. $3x^2 - 22x + 13$

56. $3x^2 - 22x + 13$

57. $3x^2 - 22x + 13$

58. $3x^2 - 22x + 13$

59. $3x^2 - 22x + 13$

60. $3x^2 - 22x + 13$

61. $3x^2 - 22x + 13$

62. $3x^2 - 22x + 13$

63. $3x^2 - 22x + 13$

64. $3x^2 - 22x + 13$

65. $3x^2 - 22x + 13$

66. $3x^2 - 22x + 13$

67. $3x^2 - 22x + 13$

68. $3x^2 - 22x + 13$

69. $3x^2 - 22x + 13$

70. $3x^2 - 22x + 13$

71. $3x^2 - 22x + 13$

72. $3x^2 - 22x + 13$

73. $3x^2 - 22x + 13$

74. $3x^2 - 22x + 13$

75. $3x^2 - 22x + 13$

76. $3x^2 - 22x + 13$

77. $3x^2 - 22x + 13$

78. $3x^2 - 22x + 13$

79. $3x^2 - 22x + 13$

80. $3x^2 - 22x + 13$

81. $3x^2 - 22x + 13$

82. $3x^2 - 22x + 13$

83. $3x^2 - 22x + 13$

84. $3x^2 - 22x + 13$

85. $3x^2 - 22x + 13$

86. $3x^2 - 22x + 13$

87. $3x^2 - 22x + 13$

88. $3x^2 - 22x + 13$

89. $3x^2 - 22x + 13$

90. $3x^2 - 22x + 13$

91. $3x^2 - 22x + 13$

92. $3x^2 - 22x + 13$

93. $3x^2 - 22x + 13$

94. $3x^2 - 22x + 13$

95. $3x^2 - 22x + 13$

96. $3x^2 - 22x + 13$

97. $3x^2 - 22x + 13$

98. $3x^2 - 22x + 13$

99. $3x^2 - 22x + 13$

100. $3x^2 - 22x + 13$

MIND OVER MATH

A hexagon is a figure consisting of 6 adjoining congruent sides.

Determine whether each figure can be formed using the pentominoes without allowing any overlaps or rotations.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23.

24.

25.

26.

27.

28.

29.

30.

31.

32.

33.

34.

35.

36.

37.

38.

39.

40.

41.

42.

43.

44.

45.

46.

47.

48.

49.

50.

51.

52.

53.

54.

55.

56.

57.

58.

59.

60.

61.

62.

63.

64.

65.

66.

67.

68.

69.

70.

71.

72.

73.

74.

75.

76.

77.

78.

79.

80.

81.

82.

83.

84.

85.

86.

87.

88.

89.

90.

91.

92.

93.

94.

95.

96.

97.

98.

99.

100.

2 CHAPTER REVIEW

Key Concepts

Simple Equations (2.1)

- Equivalent equations have the same solution.
- For one-step equations, use inverse operations to isolate the variable and solve the equation.
- For two-step equations, use the inverse order of operations when performing inverse operations on both sides.
- Check the solution by substituting into the original equation.
- Real-world problems can often be modeled and solved by following the basic problem-solving strategy (as outlined for 2.1–2.3).

Multistep Equations (2.2)

- Solve multistep equations.
- Simplify the expression on either side of both sides of an equation when possible before using inverse operations.
- Eliminate parentheses by distributing.
- If necessary, multiply both sides of an equation by the LCD to eliminate fractions.
- Combine like terms.
- If necessary, move all variables to one side of the equation.
- Use an algebraic operation to convert a repeating decimal to a fraction.
- Write an equation in which x is equal to the repeating fraction.
- Multiply both sides of this equation by 10^n , where n is the number of repeating digits.
- Find the difference between the 2 equations and solve the resulting equation.

Literal Equations (2.3)

- Use inverse operations to isolate the desired variable.
- Clear the equation of fractions by multiplying both sides by the LCD.
- Simplify both sides of the equation.
- Collect all terms containing the desired variable on one side of the equation and all other terms on the other side.
- Use the Distributive Property to isolate the desired variable.
- Divide both sides by the coefficient of the variable.

Ratios & Proportions (2.4)

- Use dimensional analysis to convert between different units or rates.

Biblical Worldview Shaping

Modeling with Algebra

Use math to understand and solve real-world problems.

Mathematical models are very effective in providing insight into the world. They can help us understand the world and make predictions about the future.

EXERCISES

1. Determine whether the given number is a solution to the equation. (2.1)

a. $x^2 + x = 6$ if $x = -2$

b. $\frac{1}{2}x - \frac{1}{3} = \frac{1}{6}$ if $x = \frac{1}{2}$

2. $x^2 + 5 = 14$

3. $x^2 + 5 = 14$

4. $x^2 + 5 = 14$

5. $x^2 + 5 = 14$

6. A local natural gas company charges small businesses a \$22 monthly connection fee and \$1.20/therm. Write and solve an equation to find the number of therms a company used during a month in which its gas bill was \$12.45. (2.1)

7. $4x - 7 = 4x + 8$

8. $4x - 7 = 4x + 8$

9. $4x - 7 = 4x + 8$

10. $4x - 7 = 4x + 8$

11. $4x - 7 = 4x + 8$

12. $4x - 7 = 4x + 8$

13. $4x - 7 = 4x + 8$

14. $4x - 7 = 4x + 8$

15. $4x - 7 = 4x + 8$

16. $4x - 7 = 4x + 8$

17. $4x - 7 = 4x + 8$

18. $4x - 7 = 4x + 8$

19. $4x - 7 = 4x + 8$

20. $4x - 7 = 4x + 8$

21. $4x - 7 = 4x + 8$

22. $4x - 7 = 4x + 8$

23. $4x - 7 = 4x + 8$

24. $4x - 7 = 4x + 8$

25. $4x - 7 = 4x + 8$

26. $4x - 7 = 4x + 8$

27. $4x - 7 = 4x + 8$

28. $4x - 7 = 4x + 8$

29. $4x - 7 = 4x + 8$

30. $4x - 7 = 4x + 8$

31. $4x - 7 = 4x + 8$

32. $4x - 7 = 4x + 8$

33. $4x - 7 = 4x + 8$

34. $4x - 7 = 4x + 8$

35. $4x - 7 = 4x + 8$

36. $4x - 7 = 4x + 8$

37. $4x - 7 = 4x + 8$

38. $4x - 7 = 4x + 8$

39. $4x - 7 = 4x + 8$

40. $4x - 7 = 4x + 8$

41. $4x - 7 = 4x + 8$

42. $4x - 7 = 4x + 8$

43. $4x - 7 = 4x + 8$

44. $4x - 7 = 4x + 8$

45. $4x - 7 = 4x + 8$

46. $4x - 7 = 4x + 8$

47. $4x - 7 = 4x + 8$

48. $4x - 7 = 4x + 8$

49. $4x - 7 = 4x + 8$

50. $4x - 7 = 4x + 8$

51. $4x - 7 = 4x + 8$

52. $4x - 7 = 4x + 8$

53. $4x - 7 = 4x + 8$

54. $4x - 7 = 4x + 8$

55. $4x - 7 = 4x + 8$

56. $4x - 7 = 4x + 8$

57. $4x - 7 = 4x + 8$

58. $4x - 7 = 4x + 8$

59. $4x - 7 = 4x + 8$

60. $4x - 7 = 4x + 8$

61. $4x - 7 = 4x + 8$

62. $4x - 7 = 4x + 8$

63. $4x - 7 = 4x + 8$

64. $4x - 7 = 4x + 8$

65. $4x - 7 = 4x + 8$

66. $4x - 7 = 4x + 8$

67. $4x - 7 = 4x + 8$

68. $4x - 7 = 4x + 8$

69. $4x - 7 = 4x + 8$

70. $4x - 7 = 4x + 8$

71. $4x - 7 = 4x + 8$

72. $4x - 7 = 4x + 8$

73. $4x - 7 = 4x + 8$

74. $4x - 7 = 4x + 8$

75. $4x - 7 = 4x + 8$

76. $4x - 7 = 4x + 8$

77. $4x - 7 = 4x + 8$

78. $4x - 7 = 4x + 8$

79. $4x - 7 = 4x + 8$

80. $4x - 7 = 4x + 8$

81. $4x - 7 = 4x + 8$

82. $4x - 7 = 4x + 8$

83. $4x - 7 = 4x + 8$

84. $4x - 7 = 4x + 8$

85. $4x - 7 = 4x + 8$

86. $4x - 7 = 4x + 8$

87. $4x - 7 = 4x + 8$

88. $4x - 7 = 4x + 8$

89. $4x - 7 = 4x + 8$

90. $4x - 7 = 4x + 8$

91. $4x - 7 = 4x + 8$

92. $4x - 7 = 4x + 8$

93. $4x - 7 = 4x + 8$

94. $4x - 7 = 4x + 8$

95. $4x - 7 = 4x + 8$

96. $4x - 7 = 4x + 8$

97. $4x - 7 = 4x + 8$

98. $4x - 7 = 4x + 8$

99. $4x - 7 = 4x + 8$

100. $4x - 7 = 4x + 8$

Chapter Review

Prepare for the chapter test with a summary of key concepts, a review of the biblical worldview theme, and review exercises.