CONTENTS

Teacher’s Guide ............................................. v

Chapter 13 Resources
Family Letter ................................................. 1
Are You Ready?
Practice Worksheet ................................. 5
  AL Review Worksheet ................................. 6
  BL Apply Worksheet ................................. 7
  Diagnostic Test ........................................... 8
  Pretest ..................................................... 9

Language Arts Resources
  Student Glossary ............................... 10

Practice and Reinforcement
  Facts Practice ................................. 11

Lesson 13-1 Lesson Resources
  A PSI: Guess, Check, and Revise
    AL Reteach ......................................... 12
    Skills Practice .................................. 13
    Homework Practice .......................... 14
    Problem-Solving Practice ................. 15
  B Solve Inequalities by Addition or Subtraction
    AL Reteach ......................................... 16
    Skills Practice .................................. 17
    Homework Practice .......................... 18
    Problem-Solving Practice ................. 19
    BL Enrich ........................................ 20
  C Solve Inequalities by Multiplication or Division
    AL Reteach ......................................... 21
    Skills Practice .................................. 22

Lesson 13-2 Lesson Resources
  A Function Notation
    AL Reteach ......................................... 26
    Skills Practice .................................. 27
    Homework Practice .......................... 28
    Problem-Solving Practice ................. 29
    BL Enrich ........................................ 30
    Scientific Calculator Activity ............ 31
  B Linear Functions
    AL Reteach ......................................... 32
    Skills Practice .................................. 33
    Homework Practice .......................... 34
    Problem-Solving Practice ................. 35
    BL Enrich ........................................ 36
    TI-73 Activity ................................. 37
  C Slope-Intercept Form
    AL Reteach ......................................... 38
    Skills Practice .................................. 39
    Homework Practice .......................... 40
    Problem-Solving Practice ................. 41
    BL Enrich ........................................ 42
    TI-84 Plus Activity ......................... 43

Lesson 13-3 Lesson Resources
  A Explore: Graphs of Nonlinear Functions
    Explore ............................................. 44
  B Linear and Nonlinear Functions
    AL Reteach ......................................... 45
    Skills Practice .................................. 46

AL = Approaching Level  BL = Beyond Level
Teacher’s Guide to Using the Chapter 13 Resource Masters

The Chapter 13 Resource Masters includes the core materials needed for Chapter 13. These materials include information for families, student worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing and printing from the online Teacher Edition.

Family Resources
Family Introduction to Course 2 (Available in Chapter 0)
- Talks about the focus of the grade level.
- Gives Web site information.

Family Letter
- English and Spanish
- Overview of the chapter
- Key vocabulary
- Provides at home activities

Chapter Resources
Are You Ready Worksheets
- Use after the Are You Ready section in the Student Edition.
  - AL Review: Approaching-level students
  - Practice: On-level students
  - BL Apply: Beyond-level students

Chapter Diagnostic Test
- Used to test skills needed for success in the upcoming chapter.
  - Retest approaching-level students after the Are You Ready worksheets.

Chapter Pretest
- Quick check of the upcoming chapter’s concepts to determine pacing.
  - Used before the chapter to gauge students’ skill level.
  - Use to determine class grouping.
Language Arts Resources

Student Glossary

- Includes key vocabulary terms from the chapter.
- Students record definitions and/or examples for each term.
- Students can use the page as a bookmark as they study the chapter.

Practice and Reinforcement

Facts Practice

- Quick recall of concepts needed in the upcoming chapter.
- Use as a timed test to gauge student mastery of prior concepts.

Lesson Resources

Explore

- Provides additional practice for the activities and exercises found in the Student Edition.
- Use as homework for same-day teaching.

Reteach

- Provides vocabulary, key concepts, additional worked-out examples, and exercises.
- Use for students who have been absent.

Skills Practice

- Focuses on the computational nature of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.

Homework Practice

- Mimics the types of problems found in the Practice and Problem Solving of the Student edition.
- Use as an additional practice.
- Use as homework for second-day teaching.

Problem-Solving Practice

- Includes word problems that apply the concepts of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.
Enrich

- Provides an extension of the concepts, offers a historical or multicultural look at the concepts, or widens students’ perspectives on the mathematics.
- For use with all levels of students.

Technology Activities

- Presents ways in which technology can be used with the concepts in some of the lessons.
- Use as an alternative approach to teaching the concept.
- Use as part of the lesson presentation.

Assessment Resources

Reflecting on Chapter 13

- Three open-ended questions
- Allows students to write about mathematics.

Chapter Quizzes

- Free-response questions
- One quiz for each multi-part lesson.

Vocabulary Test

- Includes a list of vocabulary words and questions to assess students’ knowledge of those words.
- Use in conjunction with one of the Chapter Tests.

Chapter Tests

- **AL** 1A-1B Approaching-level students
  - Contains multiple choice questions.
- 2A-2B On-level students
  - Contains both multiple choice and free response questions.
- **BL** 3A-3B Beyond-level students
  - Contains free-response questions.
- Tests A and B are the same format with different numbers.
- Use when students are absent or for different rows.
Standardized Test Practice
- Test is cumulative.
- Includes multiple-choice and short-response questions.

Extended-Response Test
- Contains performance-assessment tasks
- Sample answers are included.

Extended-Response Rubric
- The scoring rubric for the Extended-Response Test.

Student Recording Sheet
- Corresponds with the Test Practice at the end of the Student Edition chapter.

Chapter Project Rubric
- The scoring rubric for the Chapter Project found in the Teacher Edition.

Answers

Chapter and Lesson Resources
- Chapter Resources, Facts Practice, and Lesson Resources are provided as reduced pages with answers appearing in black.

Assessments
- Full-size answer keys are provided for the assessment masters.
Dear Parent or Guardian:

Today we began Chapter 13: Inequalities, Functions, and Monomials. In this chapter, your student will learn how to multiply and divide monomials. We will also be solving inequalities by addition, subtraction, multiplication and division. In addition, we will be learning about function notation and identifying linear and nonlinear functions. Included in this letter are key vocabulary words and activities you can do with your student. You may also wish to log on to glencoe.com for other study help. If you have any questions or comments, feel free to contact me at school.

Sincerely,

[Signature]

Key Vocabulary

**function notation** A form for writing the equation of a function.

**linear function** A function whose graph is a line.

**monomial** An expression consisting of a number, a variable, or a product of a number and one or more variables.

**nonlinear function** A function whose graph is not a straight line.

**scientific notation** A form for writing a number as the product of a factor between 1 and 10 and a power of 10.

**slope-intercept form** The form $y = mx + b$ for a linear function where $m$ is the slope and $b$ is the $y$-intercept.

**$x$-intercept** The point where a graph crosses the $x$-axis.

**$y$-intercept** The point where a graph crosses the $y$-axis.
At-Home Activities

Hands-On Activity

Materials: yard stick

- Measure the length and width of the largest room in your home, your yard at home, or some other large rectangular space.
- Find the area of each space.
- Write the dimensions and area in scientific notation.

Online Activity

- Find a graph that is linear and one that is nonlinear.
- Compare and contrast the two graphs.
- Write a paragraph explaining how you know that one is linear and the other is not.
Carta a la familia

Estimado padre o apoderado:

Hoy comenzamos el Capítulo 13: Desigualdades, Funciones, y monomios. En este capítulo, su estudiante aprenderá a multiplicar y dividir monomios. Además, resolveremos desigualdades mediante adición, sustracción, multiplicación y división. Conjuntamente aprenderemos sobre notación funcional y cómo identificar funciones lineales y no lineales. En esta carta se incluyen palabras del vocabulario clave y actividades que pueden realizar con su estudiante. Si desean obtener más ayuda para el estudio, visiten glencoe.com. Si tienen alguna pregunta o desean hacer algún comentario, pueden contactarme en la escuela.

Sinceramente,

Vocabulario clave

- **notación funcional**: Forma de escribir la ecuación de una función.
- **función lineal**: Función cuya gráfica es una línea recta.
- **monomio**: Expresión compuesta por un número, una variable o el producto de un número por una o más variables.
- **función no lineal**: Una función cuya gráfica no es una línea recta.
- **notación científica**: Manera de escribir un número como el producto de un factor entre 1 y 10 por una potencia de 10.
- **forma pendiente-intersección**: Forma $y = mx + b$ para una función lineal donde $m$ es la pendiente y $b$ es la intersección $y$.
- **intersección $x$**: Punto donde una gráfica cruza el eje $x$.
- **intersección $y$**: Punto donde una gráfica cruza el eje $y$. 
Actividades para el hogar

Actividad manual

**Materiales:** vara de yarda, lápiz, papel

- Midan el largo y el ancho de la habitación más grande de su casa, su patio o algún otro espacio rectangular.
- Hagan un dibujo del espacio que midieron y rotulen las dimensiones.
- Calculen el área del espacio.
- Escriban las dimensiones y el área en notación científica.

![Diagrama de una habitación](image1)

Actividad en línea

- Hallen una gráfica lineal y una que no sea lineal.
- Comparen y contrasten las dos gráficas.
- Escriban un párrafo explicando cómo saben que una es lineal y la otra no.
Practice

1. **NUTRITION** Indira is writing a project about salt content in snacks. She found that each serving of potato chips contains 410 milligrams of potassium. The equation \( p = 410s \) describes how much potassium \( p \) is in \( s \) servings of potato chips. Represent this function by a graph.

2. Graph the equation \( y = 2x - 4 \).

3. Use the information in the table to find the rate of change or slope in feet per second that a hot air balloon rises.

<table>
<thead>
<tr>
<th>Seconds</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

4. The graph shows the number of pages read each minute. Use the graph to find the rate of change.

For more examples, go to glencoe.com.
Review

**Example** Graph the equation \( y = 3x - 5 \).

Make a table of values. Choose values for \( x \), substitute them in to the equation, and find \( y \). Then graph the ordered pairs in the table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( 3x - 5 )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3(0) - 5</td>
<td>-5</td>
</tr>
<tr>
<td>1</td>
<td>3(1) - 5</td>
<td>-2</td>
</tr>
<tr>
<td>2</td>
<td>3(2) - 5</td>
<td>1</td>
</tr>
</tbody>
</table>

![Graph of the equation \( y = 3x - 5 \).]

**Exercises** Graph each equation.

1. \( y = x + 5 \)

2. \( y = \frac{1}{2} x - 1 \)

3. \( y = -2x + 3 \)
Apply

Graph the function represented by each table.

1. **STOCK** Reggie is buying stock.
   The prices are shown in the table.

<table>
<thead>
<tr>
<th>Number of Shares</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
</tr>
<tr>
<td>7</td>
<td>154</td>
</tr>
</tbody>
</table>

2. **BLUEBERRIES** Juliette is calculating the number of Calories in blueberries. Her results are shown in the table.

<table>
<thead>
<tr>
<th>Number of Cups</th>
<th>Number of Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>160</td>
</tr>
<tr>
<td>4</td>
<td>320</td>
</tr>
<tr>
<td>6</td>
<td>480</td>
</tr>
</tbody>
</table>

3. **TEMPERATURE** Find the rate of change for the data in the table showing the temperature in a room hours after the air conditioner is turned on.

<table>
<thead>
<tr>
<th>Number of Hours</th>
<th>Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>94</td>
</tr>
<tr>
<td>5</td>
<td>88</td>
</tr>
</tbody>
</table>

4. **NAIL POLISH** Find the rate of change for the graph showing the cost of bottles of nail polish.
Chapter 13

Diagnostic Test

1. Graph the function represented by the table.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Number of Ice Cubes Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>48</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
</tr>
</tbody>
</table>

2. Graph the equation \( y = -\frac{1}{3x} + 5 \).

3. Use the information in the table to find the rate of change or slope in inches per week that a weed grows.

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
</tbody>
</table>

4. The graph shows the cost per square yard of carpet. Use the graph to find the rate of change.
Pretest

For Exercises 1 and 2, solve each inequality. Graph the solution on the number line.

1. \(-13 > n - 6\)

2. \(\frac{t}{-3} \leq 2\)

3. Find \(f(6)\) if \(f(x) = x - 7\).

4. State the slope and the \(y\)-intercept of the graph of \(y = -\frac{3}{4}x + 2\).

5. Graph \(y = 2x - 5\) using the slope and \(y\)-intercept.

6. Determine whether the table represents a linear or nonlinear function.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
</tr>
</tbody>
</table>

7. Find the product of \(x^{11} \cdot x^3\).

8. Find the quotient of \(\frac{x^{11}}{x^3}\).

9. Write \(6^{-4}\) using a positive exponent.

10. Express \(2.34 \times 10^5\) in standard form.

11. Express 0.039 in scientific notation.
This is an alphabetical list of new vocabulary terms you will learn in Chapter 13. Fold the page vertically and use it as a bookmark. As you study the chapter, write each term's definition or description in as few words as possible.

<table>
<thead>
<tr>
<th>Vocabulary Word</th>
<th>Definition/Description/Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>discrete data</td>
<td></td>
</tr>
<tr>
<td>function notation</td>
<td></td>
</tr>
<tr>
<td>linear function</td>
<td></td>
</tr>
<tr>
<td>monomial</td>
<td></td>
</tr>
<tr>
<td>nonlinear function</td>
<td></td>
</tr>
<tr>
<td>scientific notation</td>
<td></td>
</tr>
<tr>
<td>slope-intercept form</td>
<td></td>
</tr>
<tr>
<td>x-intercept</td>
<td></td>
</tr>
<tr>
<td>y-intercept</td>
<td></td>
</tr>
</tbody>
</table>
# Facts Practice

Solve each equation.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $b + \frac{2}{3} = 2$</td>
<td>2. $-4 = n - 7$</td>
<td>3. $x + 9 = 22$</td>
<td>4. $12 - y = 3$</td>
</tr>
<tr>
<td>5. $t - 2 = -5$</td>
<td>6. $-6 = m + 2.6$</td>
<td>7. $8k = -56$</td>
<td>8. $\frac{x}{-5} = 4$</td>
</tr>
<tr>
<td>9. $\frac{3}{5}a + 12 = 9$</td>
<td>10. $3b - 5 = 7$</td>
<td>11. $11 + \frac{n}{-4} = 1$</td>
<td>12. $7 + 3x = 2 + x$</td>
</tr>
<tr>
<td>13. $\frac{2}{3}x - 4 = -10$</td>
<td>14. $6.2a + 3.1 = 9.3$</td>
<td>15. $5 - \frac{b}{3} = -2$</td>
<td>16. $2 - x = 4 + 3x$</td>
</tr>
</tbody>
</table>
When solving problems, one strategy that is helpful to use is guess, check, and revise. Based on the information in the problem, you can make a guess of the solution. Then use computations to check if your guess is correct. You can repeat this process until you find the correct solution.

You can use guess, check, and revise along with the following four-step problem-solving plan to solve a problem.

**Understand**
- Read and get a general understanding of the problem.

**Plan**
- Make a plan to solve the problem and estimate the solution.

**Solve**
- Use your plan to solve the problem.

**Check**
- Check the reasonableness of your solution.

**Example**

**VETERINARY SCIENCE** Dr. Miller saw 40 birds and cats in one day. Altogether the pets he saw had 110 legs. How many of each type of animal did Dr. Miller see in one day?

**Understand**
You know that Dr. Miller saw 40 birds and cats total. You also know that there were 110 legs in all. You need to find out how many of each type of animal he saw in one day.

**Plan**
Make a guess and check it. Adjust the guess until you get the correct answer.

**Solve**

<table>
<thead>
<tr>
<th>Number of Birds</th>
<th>Number of Cats</th>
<th>Total Number of Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>2(20) + 4(20) = 120</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>2(30) + 4(10) = 100</td>
</tr>
<tr>
<td>25</td>
<td>15</td>
<td>2(25) + 4(15) = 110</td>
</tr>
</tbody>
</table>

**Check**
25 birds have 50 feet. 15 cats have 60 feet. Since 50 + 60 is 110, the answer is correct.

**Exercises**

**GEOMETRY** In a math class of 26 students, each girl drew a triangle and each boy drew a square. If there were 89 sides in all, how many girls and how many boys were in the class?
Solve each problem using the guess, check, and revise strategy.

1. **SPORTS** Almena made 2-point baskets and 3-point baskets in her last basketball game. Altogether she scored 9 points. How many of each type of basket did she make?

2. **ENTERTAINMENT** Tickets to the local circus cost $3 for children and $5 for adults. There were three times as many children tickets sold as adult tickets. Altogether the circus made $700. How many children and how many adults bought tickets to the circus?

3. **NUMBERS** What are the next two numbers in the pattern?

   5, 13, 37, 109, 325, ___, ___

4. **MONEY** Clark found $2.40 in change while cleaning his couch. He found the same number of quarters, dimes, and nickels. How many of each coin did he find?

5. **COMPUTER FILES** Jan’s flash drive stores 8 gigabytes. One gigabyte is 1,024 megabytes. Jan has 2,500 songs stored on her computer's hard drive. She wants to move them to her flash drive. To the nearest hundred, about how many songs can the flash drive hold if each song is about 5 megabytes?
Use the **guess, check, and revise** strategy to solve Exercises 1 and 2.

1. **NUMBERS** A number is multiplied by 7. Then 5 is added to the product. The result is 33. What is the number?

2. **FOOD** Mr. Jones paid $23 for food for his family of seven at the ballpark. Everyone had a drink and either one hot dog or one hamburger. How many hamburgers were ordered?

<table>
<thead>
<tr>
<th><strong>MENU</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td>Hot Dog</td>
</tr>
<tr>
<td>Hamburger</td>
</tr>
<tr>
<td>Drink</td>
</tr>
</tbody>
</table>

Use any strategy to solve Exercises 3–6. Some strategies are shown below.

<table>
<thead>
<tr>
<th><strong>PROBLEM-SOLVING STRATEGIES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Guess, check, and revise.</td>
</tr>
<tr>
<td>• Find a pattern.</td>
</tr>
<tr>
<td>• Choose an operation.</td>
</tr>
</tbody>
</table>

3. ** PATTERNS** What are the next two “words” in the pattern?

   \[ ace, bdf, ceg, dfh, egi, \ldots, \ldots \]

4. **GEOMETRY** The area of each square is twice the area of the next smaller square drawn in it. If the area of the smallest square is 3 square centimeters, what is the area of the largest square?

5. **ALGEBRA** What are the next two numbers in the pattern?

   \[ 32, 28, 24, 20, \ldots, \ldots \]

6. **MONEY** Leeann received $60 for her birthday. The money came in $10 bills and $5 bills. If she received 8 bills, how many of each type did she receive?

7. **MONEY** Duane has four dimes, half as many nickels as dimes, and three times as many quarters as nickels. How much money does Duane have?

8. **LIBRARY** Mr. Shuck, the librarian, counted 157 books checked in during the day. This number was 8 less than 3 times the number of books checked out that same day. How many books were checked out that day?
1. AGE Beverly and Riva have a combined age of 34. If Riva is 2 years less than twice Beverly’s age, how old is each person?

2. NUMBER A number is divided by 3. Then 14 is added to the quotient. The result is 33. What is the original number?

3. CANDLES The Key Club made $192 at their candle sale. They sold round candles for $4 and square candles for $6. If they sold twice as many square candles as round ones, how many of each type of candle did the Key Club sell?

4. BASEBALL Landon has 37 baseball cards. If 4 cards can fit on one page, how many pages does Landon need to buy?

5. EARNINGS Quimaine earns $500 less than three times as much as Jim. If their combined salary is $49,500, how much do they each earn?

6. NUMBERS The square root of a number is subtracted from the sum of the number and 12. The result is 42. What is the original number?
Reteach
Solve Inequalities by Addition or Subtraction

Solving an inequality means finding values for the variable that make the inequality true. You can use the Addition and Subtraction Properties of Inequality to help solve an inequality. When you add or subtract the same number from each side of an inequality, the inequality remains true.

Examples

1. Solve each inequality.

   \[ x + 4 > 9 \]
   \[ x + 4 - 4 > 9 - 4 \]
   \[ x > 5 \]

   Any number greater than 5 will make the statement true. Therefore, the solution is \( x > 5 \).

   \[ -12 \geq n - 9 \]
   \[ -12 + 9 \geq n - 9 + 9 \]
   \[ -3 \geq n \]

   The solution is \(-3 \geq n \) or \( n \leq -3 \).

2. Solve \( a + \frac{1}{3} < 1 \). Graph the solution set on a number line.

   \[ a + \frac{1}{3} < 1 \]
   \[ a + \frac{1}{3} - \frac{1}{3} < 1 - \frac{1}{3} \]
   \[ a < \frac{2}{3} \]

   \[ -1 \quad 0 \quad \frac{2}{3} \quad 1 \quad 2 \quad 3 \]

Exercises

Solve each inequality.

1. \( t - 6 > 3 \)
2. \( b + 9 \leq 2 \)
3. \( 8 < r - 9 \)
4. \( -4 < p + 4 \)

Solve each inequality. Graph the solution set on a number line.

5. \( s + 8 < 9 \)
6. \( -3 \leq d - 2 \)
Solve each inequality.

1. \( a + 4 < 9 \)
2. \( e - 7 > 1 \)
3. \( -4 \geq k - 2 \)
4. \( y + 6 > 9 \)
5. \( n - 9 \geq 5 \)
6. \( -4 > h - 2 \)
7. \( -19 > x - 11 \)
8. \( 5 \leq q + 12 \)

Write an inequality and solve each problem.

9. Two less than a number is less than 9.

10. The difference between a number and 3 is no more than 2.

11. The sum of a number and 8 is more than 4.

12. Two more than a number is less than 13.

Solve each inequality. Graph the solution set on a number line.

13. \( 8 < p - 1 \)

14. \( w + 5 \geq -6 \)

15. \( 1 > x + 6 \)

16. \( 4 \leq v - 7 \)

17. \( b - 3 \leq -8 \)

18. \( m + 9 < -8 \)
Solve each inequality.
1. \( p + 9 < 7 \)
2. \( t + 6 > -4 \)
3. \( -12 \geq 7 + b \)
4. \( 16 > -15 + k \)
5. \( 25 < n - 11 \)
6. \( -8 > h - 4 \)
7. \( b - \frac{3}{4} < \frac{1}{2} \)
8. \( f - 5.2 \geq 1.6 \)

Write an inequality and solve each problem.
9. Four more than a number is no more than thirteen.
10. The difference of a number and \(-6\) is less than 9.
11. Eleven less than a number is more than seventeen.
12. The sum of \(-8\) and a number is at least 9.

Solve each inequality. Graph the solution on a number line.
13. \( n + 5 < 7 \)
14. \( t + 2 > 10 \)
15. \( p - 5 > -4 \)
16. \( 3 \leq \frac{1}{3} + n \)
17. \( 4 \geq s - \frac{3}{4} \)
18. \( 6.9 < w - 2.3 \)

19. **ENVELOPES** Sani has at least 68 envelopes to address. He has addressed 17 of them. Write and solve an inequality that describes how many more envelopes, at most, Sani has left to address.

For more examples, go to glencoe.com.
1. **DRIVING** Louella is driving from Melbourne to Pensacola, a distance of more than 500 miles. After driving 240 miles, Louella stops for lunch. Write and solve an inequality to find how much farther Louella has to drive to reach Pensacola.

2. **MONEY** Aimee and Desmond are going to a play this evening. Desmond wants to have at least $50 in his wallet. He currently has $5. Write and solve an inequality to find how much more cash Desmond should put in his wallet.

3. **FIELD TRIP** There is space for 120 students to go on a field trip. Currently, 74 students have signed up. Write and solve an inequality to find how many more students can sign up for the field trip.

4. **MUSIC** Rogan is burning a music CD. The CD holds at most 70 minutes of music. Rogan has already selected 45 minutes of music. Write and solve an inequality to find how many more minutes of music Rogan can select.

5. **HOMEWORK** Petra must write a report with more than 1,000 words for her history class. So far, she has written 684 words. Write and solve an inequality to find how many more words Petra needs to write for her report.

6. **HEIGHT** Leslie hopes to be at least 72 inches tall. Right now he is 56 inches tall. Write and solve an inequality to find how much more Leslie would like to grow.

7. **INTERNET** Julius is allowed to surf the Internet for only 3 hours a week. He has already been online for 1 2/3 hours this week. Write and solve an inequality to find how much more time Julius can spend online this week.

8. **GROCERIES** The table shows how much Colleen has spent at the grocery store this week. To stay within her budget, she can spend only $90 per week on groceries. Write and solve an inequality to find how much more Colleen can spend at the grocery store this week.

<table>
<thead>
<tr>
<th>Day</th>
<th>Amount Spent ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>28</td>
</tr>
<tr>
<td>Wednesday</td>
<td>39</td>
</tr>
</tbody>
</table>
**Enrich**

**Solve Inequalities of the Form \( a < x + b < c \)**

**Example 1**

Solve \( 5 < x + 9 < 12 \).

\[
5 < x + 9 < 12 \\
5 - 9 < x + 9 - 9 < 12 - 9 \\
-4 < x < 3
\]

Write the inequality. Subtract 9 from all 3 parts. Simplify.

The solution is all the numbers between \(-4\) and \(3\).

**Example 2**

Solve and graph the solution set of \(-2 \leq x - 3 < 7\).

\[
-2 \leq x - 3 < 7 \\
-2 + 3 \leq x - 3 + 3 < 7 + 3 \\
1 \leq x < 10
\]

Write the inequality. Add 3 to all 3 parts. Simplify.

The solution is all numbers between \(1\) and \(10\), including \(1\). The graph will have a closed circle on \(1\), an open circle on \(10\), and the line between them shaded.

---

**Exercises**

Solve and graph the solution set for each inequality.

1. \( 2 < x - 4 < 5 \)

2. \( -3 \leq x + 8 \leq 1 \)

3. \( -6 < x - 9 \leq -4 \)

4. \( 5 \leq x + 3 < 8 \)

5. \( 3 > x - \frac{1}{2} \geq 0 \)

6. \( \frac{2}{5} < x + \frac{3}{5} < 1 \)
Reteach

Solve Inequalities by Multiplication or Division

When you multiply or divide each side of an inequality by a positive number, the inequality remains true. However, when you multiply or divide each side of an inequality by a negative number, the direction of the inequality must be reversed for the inequality to remain true.

Example 1

Solve \(-\frac{t}{6} \leq -4\). Then graph the solution set on a number line.

\[ \frac{t}{-6} \leq -4 \]

Write the inequality.

\[ \frac{t}{-6}(-6) \leq -4(-6) \]

Multiply each side by \(-6\) and reverse the inequality symbol.

\[ t \geq 24 \]

Simplify.

To graph the solution, place a closed circle at 24 and draw a line and arrow to the right.

Example 2

Solve \(\frac{4}{5}x - 5 < 23\).

\[ \frac{4}{5}x - 5 < 23 \]

Write the inequality.

\[ \frac{4}{5}x - 5 + 5 < 23 + 5 \]

Add 5 to each side.

\[ \frac{4}{5}x < 28 \]

Simplify.

\[ \left(\frac{5}{4}\right)\frac{4}{5}x < \left(\frac{5}{4}\right)28 \]

Multiply each side by \(\frac{5}{4}\).

\[ x < 35 \]

Simplify.

Exercises

Solve each inequality. Then graph the solution on a number line.

1. \(3a > 12\)

2. \(6 \geq \frac{r}{-2}\)

Solve each inequality. Check your solution.

3. \(-3.1c + 2 \geq 2\)

4. \(13 > \frac{2}{3}y - 3\)

5. \(\frac{h}{-5} - 6 < -10\)

6. \(6a + 13 \leq 31\)
Solve each inequality. Then graph the solution set on a number line.

1. \(3v > 12\)

2. \(\frac{p}{4} < -15\)

3. \(-12 \leq -3g\)

4. \(60 \geq 12c\)

5. \(\frac{a}{2} > -4\)

6. \(1 \leq \frac{u}{5}\)

7. \(-14 \geq 7n\)

8. \(-4d \geq -36\)

Solve each inequality. Check your solution.

9. \(3a + 6 < -10\)

10. \(\frac{b}{5} - 4 \geq -29\)

11. \(\frac{m}{2} + 6 < 10\)

12. \(\frac{2}{3} + \frac{1}{6}r > -1\)

13. \(-6d + 7 \leq 1\)

14. \(\frac{z}{-8} - 5 < -3\)

15. \(-2y - 5 \leq 31\)

16. \(2.1n \leq -4.6n + 13.4\)

17. \(3x + 2 < x - 6\)

18. \(y - 3 > 2y - 7\)

19. \(\frac{a}{4} + 5 < a - 4\)

20. \(1.5g - 12 > \frac{3g}{4}\)
13-1

C

Homework Practice

Solve Inequalities by Multiplication or Division

Solve each inequality. Graph the solution set on a number line.

1. \(-8 \leq 8w\)

2. \(-6a > 66\)

3. \(-25t \leq -500\)

4. \(18 > -3g\)

5. \(\frac{y}{4} \leq 1.6\)

6. \(\frac{r}{-2} < -6\)

7. \(-8 > \frac{k}{-0.2}\)

8. \(\frac{m}{-8} \leq -2.4\)

Solve each inequality. Check your solution.

9. \(13a \geq -39\)

10. \(-15 \leq 3b\)

11. \(-3m \geq -21\)

12. \(-5 \geq \frac{c}{3.2}\)

13. \(-19 > \frac{y}{0.2}\)

14. \(\frac{-1}{3}x > -4\)

15. TEXT MESSAGES Nadine can send or receive a text message for $0.15 or get an unlimited number for $5.00. Write and solve an inequality to find how many messages she can send and receive so the unlimited plan is cheaper than paying for each message.
1. **PLANTS** Trini needs more than 51 cubic feet of soil to top up his raised garden. Each bag of soil contains 1.5 cubic feet. Write and solve an inequality to find how many bags of soil Trini needs.

2. **PETS** Becky wants to buy some fish for her aquarium. She has $20 to spend and the fish cost $2.50 each. Write and solve an inequality to find how many fish Becky can afford.

3. **PIZZA** Vikram and four of his friends are planning to split a pizza. They want to spend at most $4 per person. Write and solve an inequality to find the maximum cost of the pizza they can order.

4. **ROLLS** Sadie wants to make several batches of rolls. She has 13 tablespoons of yeast left in the jar and each batch of rolls takes $2\frac{1}{4}$ tablespoons. Write and solve an inequality to find the number of batches of rolls Sadie can make.

5. **CONSTRUCTION** Vance wants to have pictures framed. Each frame and mat costs $32 and he has at most $150 to spend. Write and solve an inequality to find the number of pictures he can have framed.

6. **RECTANGLE** You are asked to draw a rectangle with a width of 5 inches and an area less than 55 square inches. Write and solve an inequality to find the length of the rectangle.

7. **BABYSITTING** Hermes gets $4 an hour for babysitting. He needs to earn at least $100 for a stereo. Write and solve an inequality to find the number of hours he must babysit to earn enough for the stereo.

8. **TIME** The table shows how many minutes per day Terri spends on the phone and watching television. If she has 180 minutes in the day for leisure activities, write and solve an inequality to find the number of minutes she can spend listening to music.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talking on phone</td>
<td>25</td>
</tr>
<tr>
<td>Watching television</td>
<td>120</td>
</tr>
</tbody>
</table>
**Example 1**  Solve and graph the solution set of \( x + 3 > 6 \) or \( x - 2 \leq -1 \).

\[
\begin{align*}
x + 3 & > 6 \\
x + 3 - 3 & > 6 - 3 \\
x & > 3 \\
x - 2 & \leq -1 \\
x - 2 + 2 & \leq -1 + 2 \\
x & \leq 1
\end{align*}
\]

“Or” means the union of the two solution sets, so you graph all the numbers that are solutions of one or the other or both inequalities on the same number line.

The solution set is \( x > 3 \) or \( x \leq 1 \).

The graph has an open circle on 3 and a line with an arrow to the right, and a closed circle on 1 and a line with an arrow to the left.

\[ \text{Graph} \]

**Example 2**  Solve \( x - 4 > 1 \) and \( 2x < 12 \).

\[
\begin{align*}
x - 4 & > 1 \\
x - 4 + 4 & > 1 + 4 \\
x & > 5 \\
2x & < 12 \\
\frac{2x}{2} & < \frac{12}{2} \\
x & < 6
\end{align*}
\]

“And” means the intersection of the two solution sets, so you graph the numbers that are solutions to both inequalities.

The solution set is \( x > 5 \) and \( x < 6 \). This can also be written \( 5 < x < 6 \).

The graph has an open circle on 5, an open circle on 6, and the line is shaded between 5 and 6.

\[ \text{Graph} \]

**Exercises**

Solve and graph the solution set for each compound inequality.

1. \( x - 3 \geq 5 \) or \( x + 2 < 3 \)

2. \( 3x < 9 \) and \( x - 4 > -6 \)

3. \( -2x < 6 \) or \( x + 5 \geq 9 \)
**Reteach**

**Function Notation**

A relationship that assigns exactly one output value for each input value is called a function. A function that is written as an equation can also be written in a form called **function notation**. To find the value of a function for a certain number, replace the input with the number and evaluate the expression.

### Example 1

**Find** \( f(5) \) **if** \( f(x) = 2 + 3x \).

\[
f(x) = 2 + 3x \\
f(5) = 2 + 3(5) \text{ or } 17
\]

So, \( f(5) = 17 \).

You can organize the input, rule, and output of a function using a function table.

### Example 2

**Complete the function table for** \( f(x) = 2x + 4 \).

Substitute each value of \( x \), or input, into the function rule. Then simplify to find the output.

<table>
<thead>
<tr>
<th>Input ( x )</th>
<th>Rule ( 2x + 4 )</th>
<th>Output ( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>2(-1) + 4</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>2(0) + 4</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>2(1) + 4</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>2(2) + 4</td>
<td>8</td>
</tr>
</tbody>
</table>

The domain is \{-1, 0, 1, 2\}. The range is \{2, 4, 6, 8\}.

### Exercises

**Find each function value.**

1. \( f(2) \) **if** \( f(x) = x + 6 \)
2. \( f(6) \) **if** \( f(x) = -2x \)
3. \( f(4) \) **if** \( f(x) = 3x - 7 \)
4. \( f(9) \) **if** \( f(x) = -3x + 12 \)

**Complete each function table. Then state the domain and range of the function.**

5. \( f(x) = x - 8 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( x - 8 )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>-9</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-8</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-6</td>
<td></td>
</tr>
</tbody>
</table>

6. \( f(x) = 4 - 5x \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( 4 - 5x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-14</td>
<td></td>
</tr>
</tbody>
</table>
Skills Practice

Function Notation

Find each function value.

1. \( f(2) \) if \( f(x) = x + 1 \)
2. \( f(9) \) if \( f(x) = x - 4 \)
3. \( f(3) \) if \( f(x) = 2x + 3 \)
4. \( f(6) \) if \( f(x) = 2x - 7 \)
5. \( f(-7) \) if \( f(x) = 3x + 2 \)
6. \( f(8) \) if \( f(x) = -5x - 1 \)
7. \( f(-5) \) if \( f(x) = 4x + 6 \)
8. \( f(-3) \) if \( f(x) = -4x - 8 \)
9. \( f(0) \) if \( f(x) = 10 - 3x \)
10. \( f(7) \) if \( f(x) = -12 - 2x \)

Complete each function table. Then state the domain and range of the function.

11. \[
\begin{array}{ccc}
  x & x - 11 & f(x) \\
  -2 & & \\
  -1 & & \\
  1 & & \\
  2 & & \\
\end{array}
\]

12. \[
\begin{array}{ccc}
  x & 2x + 5 & f(x) \\
  -1 & & \\
  0 & & \\
  1 & & \\
  2 & & \\
\end{array}
\]

13. \[
\begin{array}{ccc}
  x & 7 - 3x & f(x) \\
  0 & & \\
  2 & & \\
  4 & & \\
  6 & & \\
\end{array}
\]

14. \[
\begin{array}{ccc}
  x & 1 + 4x & f(x) \\
  -2 & & \\
  0 & & \\
  2 & & \\
  4 & & \\
\end{array}
\]
Homework Practice
Function Notation

Find each function value.
1. \( f(6) \) if \( f(x) = -4x \)
2. \( f(8) \) if \( f(x) = x + 14 \)
3. \( f(3) \) if \( f(x) = 2x - 1 \)
4. \( f(5) \) if \( f(x) = -3x - 2 \)
5. \( f(-6) \) if \( f(x) = 4x + 9 \)
6. \( f(-14) \) if \( f(x) = -2x - 5 \)
7. \( f\left(\frac{2}{3}\right) \) if \( f(x) = 3x - \frac{1}{3} \)
8. \( f\left(\frac{3}{4}\right) \) if \( f(x) = -2x + \frac{1}{2} \)

Complete each function table. Then state the domain and range of the function.
9. 
\[
\begin{array}{ccc}
 x & 5x - 6 & f(x) \\
-4 & & \\
-1 & & \\
2 & & \\
5 & & \\
\end{array}
\]
10. 
\[
\begin{array}{ccc}
 x & 6 + 4x & f(x) \\
-3 & & \\
0 & & \\
2 & & \\
6 & & \\
\end{array}
\]

11. 
\[
\begin{array}{ccc}
 x & -9x & f(x) \\
-3 & & \\
-1 & & \\
1 & & \\
3 & & \\
\end{array}
\]
12. 
\[
\begin{array}{ccc}
 x & 2x - 7 & f(x) \\
-6 & & \\
-4 & & \\
1 & & \\
4 & & \\
\end{array}
\]

13. **JERSEYS** The school basketball team wants to have each player’s name imprinted on the back of the player’s jersey. The cost is $60 plus $7.50 for each name. Write a function to represent the cost \( c \) for \( n \) names. What is the cost to have names imprinted on 12 jerseys?

*For more examples, go to glencoe.com.*
1. **SQUARE** The perimeter of a square equals 4 times the length of one side. Write a function using two variables for this situation.

2. **ELECTRICIANS** The I Wire It Company charges $60 for a service call plus $50 per hour for labor. The function $f(x) = 50x + 60$, where $x$ represents the number of hours of labor, can be used to find the total charge. Make a function table to show the total amount I Wire It charges if jobs take 1 hour, 2 hours, 3 hours, and 5 hours.

3. **JOBS** Helene works as a teller at the local bank. She makes $90 per day plus $5 for each new account she opens. The total amount Helene earns in one day can be found using the function $f(x) = 5x + 90$, where $x$ represents the number of new accounts she opens. Find $f(3)$ and explain what it represents.

4. **TICKETS** Tickets can be ordered through the mail for a musical. The tickets cost $65 each and there is a $3 service charge. Write a function using two variables for this situation.

5. **TICKETS** Explain how to find the cost of 6 tickets using the function you wrote for Exercise 4. Then find the cost.

6. **BOOKS** The table shows the shipping cost $f(x)$ for $x$ books. Write a function for the data in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>
Find Function Values from a Graph

The graph shows the function \( f(x) \).

1. Find \( f(2) \).
   Finding \( f(2) \) means finding the value of the function when \( x = 2 \). On the graph, find 2 on the x-axis. Follow this line up until you meet the graph of \( f(x) \). This occurs at 4. Therefore, \( f(2) = 4 \).

2. Find \( f(-4) + f(3) \).
   Find both values for \( f(-4) \) and \( f(3) \) and then add them.
   \( f(-4) = 2 \) and \( f(3) = 4 \)
   \( f(-4) + f(3) = 2 + 4 = 6 \)

Exercises

Use the graph above to find each value.

1. \( f(6) \)  
2. \( f(-1) \)
3. \( f(2) \)  
4. \( f(-4) \)
5. \( f(4) + f(-5) \)  
6. \( f(0) - f(1) \)

Use the graph of \( g(x) \) shown below to find each value.

7. \( g(0) \)  
8. \( g(2) \)
9. \( g(-4) \)  
10. \( g(1) \)
11. \( g(-3) + g(-1) \)  
12. \( g(3) - g(-5) \)
Scientific Calculator Activity

Function Tables

A calculator can be useful in making a function table.

Example

Make a function table to find the range of \( f(n) = 2n - 4 \) if the domain is \{-4, 3\}.

Enter: \( 2 \times (-) 4 \) Enter \(-12\)

\( f(-4) = -12 \)

Enter: \( 2 \times 3 \) Enter \( 2\)

\( f(3) = 2 \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>( 2n - 4 )</th>
<th>( f(n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>2(-4) - 4</td>
<td>-12</td>
</tr>
<tr>
<td>3</td>
<td>2(3) - 4</td>
<td>2</td>
</tr>
</tbody>
</table>

Exercises

Complete each function table.

1. \( f(n) = -4n - 3 \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>(-4n - 3)</th>
<th>( f(n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-13</td>
<td></td>
</tr>
</tbody>
</table>

2. \( f(n) = 0.5n + 4.5 \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>( 0.5n + 4.5)</th>
<th>( f(n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>-1.5</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>-0.5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9.0</td>
<td></td>
</tr>
</tbody>
</table>

3. \( f(n) = -12 - 0.2n \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>(-12 - 0.2n)</th>
<th>( f(n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.5</td>
<td>-11.5</td>
<td></td>
</tr>
<tr>
<td>-0.1</td>
<td>-11.2</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>-12.4</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>-13.6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-16.8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>-19.6</td>
<td></td>
</tr>
</tbody>
</table>

4. \( f(n) = -2.5n \)

<table>
<thead>
<tr>
<th>( n )</th>
<th>(-2.5n)</th>
<th>( f(n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>-1.2</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>-3.75</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>-6.25</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>-25</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>-45</td>
<td></td>
</tr>
</tbody>
</table>
Reteach

Linear Functions

Functions can be represented in words, in a table, as an equation, with a graph, and as ordered pairs. The **x-intercept** is where the graph crosses the x-axis. The **y-intercept** is where the graph crosses the y-axis. A function in which the graph of the solutions forms a line is called a **linear function**.

**Example**

Graph \( y = x - 4 \).

Use intercepts.

**Step 1** Find the \( x \)-intercept.

To find the \( x \)-intercept, let \( y = 0 \).

\[
y = x - 4
\]

\[
0 = x - 4 \quad \text{Replace } y \text{ with } 0.
\]

\[
0 + 4 = x - 4 + 4 \quad \text{Add 4 to each side.}
\]

\[
4 = x
\]

Since \( x = 4 \) when \( y = 0 \), graph the ordered pair (4, 0).

**Step 2** Find the \( y \)-intercept.

To find the \( y \)-intercept, let \( x = 0 \).

\[
y = x - 4
\]

\[
y = 0 - 4 \quad \text{Replace } x \text{ with } 0.
\]

\[
y = -4 \quad \text{Simplify.}
\]

Since \( y = -4 \) when \( x = 0 \), graph the ordered pair (0, -4).

**Step 3** Connect the points with a line.

**Exercises**

Graph each function.

1. \( y = x + 1 \)

2. \( y = 2x + 3 \)
Skills Practice
Linear Functions

Graph each function.

1. \( y = x + 3 \)

2. \( y = 4x - 1 \)

3. \( y = x - 5 \)

4. \( y = 2x - 4 \)

5. \( y = 3 - x \)

6. \( y = 3x - 1 \)

7. \( y = \frac{x}{2} - 2 \)

8. \( y = -\frac{x}{3} + 1 \)
Graph each function.

1. \( y = 3x \)
   ![Graph of \( y = 3x \)]

2. \( y = -2x \)
   ![Graph of \( y = -2x \)]

3. \( y = x - 1 \)
   ![Graph of \( y = x - 1 \)]

4. \( y = x + 2 \)
   ![Graph of \( y = x + 2 \)]

5. \( y = 2x + 1 \)
   ![Graph of \( y = 2x + 1 \)]

6. \( y = \frac{1}{3}x - 1 \)
   ![Graph of \( y = \frac{1}{3}x - 1 \)]

7. **CARPENTRY** Mrs. Warren can assemble a chair in 2 days and a table in 5 days. Graph the function \( y = -\frac{2}{5}x + 4 \) to determine how many of each type of furniture Mrs. Warren can assemble in 20 days.

8. **FITNESS** A fitness center has set a goal to have 500 members. The fitness center already has 250 members and adds an average of 30 members per month.
   a. Make a table and graph to find how many members the club will have after 8 months.
   
<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>250</td>
<td>280</td>
<td>310</td>
<td>340</td>
<td>370</td>
<td>400</td>
<td>430</td>
<td>460</td>
</tr>
</tbody>
</table>

   b. Is part an example of discrete or continuous data?

**Get Connected** For more examples, go to glencoe.com.
1. **FUEL CONSUMPTION** Herb can drive his truck 20 miles on each gallon of gasoline.
   a. Make a table to find how far Herb can drive on 5 gallons of gasoline.
   b. Is part an example of discrete or continuous data?

2. **HOTELS** The function \( c = 0.5m + 1 \) describes the cost \( c \) in dollars of a phone call that lasts \( m \) minutes made from a room at the Shady Tree Hotel. Graph the function. Use the graph to determine how much a 7-minute call will cost.

3. **COMPUTERS** A computer store charges $75 for materials and $50 an hour for service to install two new programs and an E-mail connection. The cost \( C \) is a function of the number of hours \( h \) it takes to do the job. Graph the function \( C = 75 + 50h \). How much will a 3-hour installation cost?

4. **GIFTS** Akilah received $400 in cash gifts for her fourteenth birthday. The function \( y = 400 - 25x \) describes the amount \( y \) remaining after \( x \) weeks if Akilah spends $25 each week. Graph the function and determine the amount remaining after 9 weeks.

5. **GIFTS** Explain how you can use your graph in Exercise 4 to determine during which week the amount remaining will fall below $160. Then find the week.

6. **CELL PHONES** Sheldon got a cell phone rate of \( C = 0.15a \). How much will a five minute call cost?
**13-2**

**B**

**Enrich**

**Parallel Lines**

You can analyze the graph of a pair of functions to determine if they are parallel.

**Example**

Graph \( y = 2x - 4 \) and \( y = 2x + 6 \) on the same graph.

Find the \( x \)-intercepts. Replace \( y \) with 0.

\[
0 = 2x - 4 \quad 0 = 2x = 6 \\
4 = 2x \quad -6 = 2x \\
2 = x \quad -3 = x
\]

Find the \( y \)-intercepts. Replace \( x \) with 0.

\[
y = 2(0) - 4 \quad y = 2(0) + 6 \\
y = -4 \quad y = 6
\]

Graph the points and draw the lines.

![Graph of parallel lines](image)

The slope of each line is 2. The \( y \)-intercepts are different. Because the slopes are the same, the lines are parallel.

**Exercises**

Graph both lines on the same graph and state if the lines are parallel.

1. \( y = \frac{1}{2}x + 1 \)  
   \( y = \frac{1}{2}x - 2 \)

2. \( y = -\frac{1}{4}x + 3 \)  
   \( y = 4x - 5 \)

State whether or not the lines are parallel.

3. \( y = 5x - 10 \quad 4. \ y = \frac{2}{3}x - 7 \quad 5. \ y = \frac{3}{4}x - 2 \quad 6. \ y = 1 - 2x \)
   
   \( y = 5x + 2 \quad \quad \quad y = -\frac{2}{3}x - 1 \quad \quad \quad y = \frac{3}{4}x + 2 \quad \quad \quad y = 1 + \frac{1}{2}x \)
13-2

TI-73 Activity

Linear Functions

A graphing calculator is a valuable tool for studying functions. The viewing window on the calculator can show various parts of the coordinate plane and use various scales. The *standard* window is \([-10, 10]\) by \([-10, 10]\) with a scale factor of 1 on both axes. You can select the standard window or set the window to fit the function you are graphing.

**Examples**

Graph \(y = 3x - 1\).

**Step 1**
To clear the graph window, turn off all plots. 

2nd [PLOT] 4 ENTER

**Step 2**
Choose the standard window (Zstandard) for the graph. 

ZOOM 6

**Step 3**
Enter the function. (If other functions are already entered, use CLEAR to remove them.)

\[ Y = 3x - 1 \]

**Step 4**
Graph the function.

To change the window, press WINDOW. Change Xmin to -5 and Xmax to 5. Press GRAPH to see the changes. (Be sure to use the \((-)\) key for negative numbers.)

Press TRACE and use the cursor keys to see the coordinates of points on the function graph. The function is displayed in the upper left corner.

**Exercises**

Graph each linear function on a graphing calculator. Then sketch the graph on a piece of paper.

1. \(y = x - 4\)
2. \(y = 4 - x\)
3. \(y = 5\)

4. \(y = 3x\)
5. \(y = 3x + 5\)
6. \(y = -3x\)

7. Describe the graphs of \(y = x - 4\) and \(y = 4 - x\).

8. What will the graph of \(y = c\) look like if \(c\) is any number?
Linear equations are often written in the form \( y = mx + b \). This is called **slope-intercept form**. When an equation is written in this form, \( m \) is the slope and \( b \) is the \( y \)-intercept.

**Example 1**  
State the slope and \( y \)-intercept of the graph of \( y = \frac{3}{4}x - 3 \).

\[
\begin{align*}
  y &= \frac{3}{4}x - 3 \\
  y &= \frac{3}{4}x + (-3) \\
  y &= mx + b \\
  m &= \frac{3}{4}, \quad b = -3
\end{align*}
\]

The slope of the graph is \( \frac{3}{4} \), and the \( y \)-intercept is \(-3\).

**Example 2**  
Graph \( y = -2x + 3 \) using the slope and \( y \)-intercept.

**Step 1**  
Find the slope and \( y \)-intercept.

- \( \text{slope} = -2 \)
- \( \text{\( y \)-intercept} = 3 \)

**Step 2**  
Graph the \( y \)-intercept point at \((0, 3)\).

**Step 3**  
Write the slope \(-2\) as \(\frac{-2}{1} \). Use it to locate a second point on the line.

\[
\begin{align*}
  m &= -2 \\
  \frac{\text{change in } y}{1} &= \text{down 2 units} \\
  \frac{\text{change in } x}{1} &= \text{right 1 unit}
\end{align*}
\]

**Step 4**  
Draw a line through the two points.

**Step 5**  
Check by locating another point on the line and substituting the coordinates into the original equation.

**Exercises**

State the slope and \( y \)-intercept for the graph of each equation.

1. \( y = x + 4 \)  
2. \( y = -\frac{2}{3}x - 1 \)

Graph each equation using the slope and \( y \)-intercept.

3. \( y = -3x + 5 \)  
4. \( y = \frac{1}{2}x - 2 \)
State the slope and the y-intercept for the graph of each equation.

1. \( y = x + 6 \)  
2. \( y = 5x - 2 \)  
3. \( y = 2x - 8 \)

4. \( y = -x + 2 \)  
5. \( y = \frac{1}{2}x - 6 \)  
6. \( y = -\frac{1}{4}x + 3 \)

7. \( y = 3x + 4 \)  
8. \( y = 6x - 1 \)  
9. \( y = \frac{5}{2}x - 7 \)

Graph each equation using the slope and y-intercept.

10. \( y = 4x - 3 \)  
11. \( y = -x + 5 \)  
12. \( y = \frac{1}{3}x - 2 \)

13. \( y = 3x - 1 \)  
14. \( y = -\frac{3}{2}x + 4 \)  
15. \( y = \frac{2}{3}x - 5 \)

16. \( y = \frac{1}{2}x + 1 \)  
17. \( y = -\frac{1}{3}x + 1 \)  
18. \( y = 2x - 2 \)
State the slope and the \( y \)-intercept for the graph of each equation.

1. \( y = 5x + 2 \)
2. \( y = -4x + 8 \)
3. \( y = 4 - x \)
4. \( y = -\frac{5}{6}x + 7 \)
5. \( y = 3x - 9 \)
6. \( y = \frac{2}{5}x + 3 \)

Graph each equation using the slope and the \( y \)-intercept.

7. \( y = -2x + 4 \)
8. \( y = x - 3 \)
9. \( y = \frac{2}{3}x + 1 \)

10. **CAMPING** The entrance fee to the national park is $25. A campsite fee is $20 per night. The total cost \( y \) for a camping trip for \( x \) nights can be represented by the equation \( y = 20x + 25 \).

   a. Graph the equation.
   
   b. Use the graph to find the total cost for 4 nights.
   
   c. What do the slope and the \( y \)-intercept represent?

11. **GEOMETRY** Use the diagram shown.

   a. Graph the equation.
   
   b. Use the graph to find the value of \( y \) if \( x = 40 \).

---

*Get Connected*  
For more examples, go to glencoe.com.
Problem-Solving Practice

Slope-Intercept Form

CAR RENTAL  For Exercises 1 and 2, use the following information. Ace Car Rentals charges $40 per day plus a $10 charge for a second driver. The total cost can be represented by the equation $y = 40x + 10$, where $x$ is the number of days and $y$ is the total cost.

1. Graph the equation. What do the slope and $y$-intercept represent?  

2. Explain how to use your graph to find the total cost of renting a car for 7 days. Then find this cost.

![Graph of CAR RENTAL equation]

TRAVEL For Exercises 3 and 4, use the following information. Quentin is driving from West Palm Beach to Gainesville, a distance of 270 miles. He drives at a constant speed of 60 miles per hour. The equation for the distance yet to go is $y = 270 - 60x$, where $x$ is the number of hours since he left.

3. What is the slope and $y$-intercept? Explain how to use the slope and $y$-intercept to graph the equation. Then graph the equation.

4. What is the $x$-intercept? What does it represent?

![Graph of TRAVEL equation]
Another form for writing a linear equation for a nonvertical line is called **point-slope form**. The point-slope form is \( y - y_1 = m(x - x_1) \) where \( m \) is the slope of the line and \((x_1, y_1)\) is a given point on the line.

**Example 1**

**State the slope and coordinates of a point on the line having the equation** \( y + 4 = 6(x - 5) \).

\[
\begin{align*}
  y + 4 &= 6(x - 5) \\
  y - (-4) &= 6(x - 5)
\end{align*}
\]

Write the equation. Rewrite the equation in point-slope form.

The slope of the line is 6 and a point on the line is \((5, -4)\).

**Example 2**

**Graph** \( y - 3 = -4(x + 1) \) **using a point and the slope**.

The slope is \(-4\) and a point on the line is \((-1, 3)\).

Graph the point.

Rewrite the slope as a fraction: \(-4 = \frac{-4}{1}\).

Move 4 down and 1 to the right from the point.

Draw a line through the two points.

**Exercises**

State the slope and coordinates of a point on each line.

1. \( y - 2 = 3(x - 5) \)  
2. \( y + 1 = -2(x + 4) \)  
3. \( y - 6 = \frac{1}{2}(x + 2) \)  
4. \( y + 5 = -\frac{2}{3}(x - 6) \)

Graph each line using the slope and a point on the line.

5. \( y + 2 = \frac{1}{2}(x + 3) \)  
6. \( y - 4 = -2(x - 1) \)
**Example**

Graph \( y = 3x - 7 \)

**Step 1** Enter \( y = 3x - 7 \).

\[
\begin{align*}
&\text{Y=} \quad 3 \quad \text{X,T,\theta,n} \quad - 7 \\
&\text{2nd} \quad \text{GRAPH}
\end{align*}
\]

**Step 2** Look at the table of values.

\[
\begin{align*}
&\text{2nd} \quad \text{WINDOW} \quad 1 \quad \text{ENTER} \quad 1
\end{align*}
\]

**Step 3** Graph several ordered pairs from the table on graph paper.

If you do not have integer values in the table, reset the table values.

Be sure you CLEAR the \( \text{Y=} \) menu before you enter another equation.

**Exercises**

Use a table of values on your graphing calculator to draw the graph of each function.

1. \( y = -2x + 6 \)

2. \( y = x^2 - 3 \)

3. \( y = -x^2 + 2x \)

4. \( y = \frac{1}{2} x^2 + 4x + 6 \)
Graphs of Nonlinear Functions

Pryor has 2 investments. One investment of $1,000 increases by 5% each year. The other $1,000 investment increases by $55 each year. Which investment will be worth the most in 5 years?

1. Make a table representing the value of Investment 1 each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,050.00</td>
</tr>
<tr>
<td>2</td>
<td>1,102.50</td>
</tr>
<tr>
<td>3</td>
<td>1,157.63</td>
</tr>
<tr>
<td>4</td>
<td>1,215.51</td>
</tr>
<tr>
<td>5</td>
<td>1,276.29</td>
</tr>
</tbody>
</table>

2. Make a table representing the value of Investment 2 each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,055.00</td>
</tr>
<tr>
<td>2</td>
<td>1,110.00</td>
</tr>
<tr>
<td>3</td>
<td>1,165.00</td>
</tr>
<tr>
<td>4</td>
<td>1,220.00</td>
</tr>
<tr>
<td>5</td>
<td>1,275.00</td>
</tr>
</tbody>
</table>

3. Graph each table on the same graph.

4. Which investment is worth more after 5 years? How much?

5. Find the rate of change between consecutive years for each investment.

6. WRITE MATH Which function is linear? Explain.
Linear functions, which have graphs that are straight lines, represent constant rates of change. The rate of change for nonlinear functions is not constant. Therefore, its graphs are not straight lines.

The equation for a linear function can always be written in the form $y = mx + b$, where $m$ represents the constant rate of change. You can determine whether a function is linear by examining its equation. In a linear function, the power of $x$ is always 1 or 0, and $x$ does not appear in the denominator of a fraction.

**Example 1** Determine whether $y = 2.5x$ represents a linear or nonlinear function. Explain.

Since the equation can be written as $y = 2.5x + 0$, the function is linear.

A nonlinear function does not increase or decrease at the same rate. You can use a table to determine if the rate of change is constant.

**Example 2** Determine whether the table represents a linear or nonlinear function. Explain.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td>10</td>
<td>-4</td>
</tr>
</tbody>
</table>

As $x$ increases by 4, $y$ decreases by a different amount each time. The rate of change is not constant, so this function is nonlinear.

**Exercises**

Determine whether each table or equation represents a linear or nonlinear function. Explain.

1. $y = 8 - 3x$

2. $x$ | $y$
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>

3. $y = 4 + \frac{1}{x}$

4. $x$ | $y$
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-7</td>
</tr>
<tr>
<td>4</td>
<td>-1</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>
Skills Practice

Linear and Nonlinear Functions

Determine whether each table or equation represents a linear or nonlinear function.

Explain.

1. \( y = 2x^2 + 6 \)  
2. \( y = \frac{-3x}{5} \)

3. \( y = 8 - 9x \)  
4. \( y = \frac{9}{x} \)

5. \( y = x^3 \)  
6. \( y = 3x + 6 \)

7. \( y = -x^2 + 8x \)  
8. \( y = 2x \)

9. 

\[
\begin{array}{c|cccc}
 x & 1 & 2 & 3 & 4 \\
 y & -2 & 0 & 2 & 4 \\
\end{array}
\]

10. 

\[
\begin{array}{c|cccc}
 x & -1 & 0 & 1 & 2 \\
 y & 12 & 9 & 6 & 3 \\
\end{array}
\]

11. 

\[
\begin{array}{c|cccc}
 x & 2 & 3 & 4 & 5 \\
 y & 7 & 9 & 12 & 14 \\
\end{array}
\]

12. 

\[
\begin{array}{c|cccc}
 x & -3 & 0 & 3 & 6 \\
 y & 10 & 1 & 10 & 37 \\
\end{array}
\]

13. 

\[
\begin{array}{c|cccc}
 x & -2 & -1 & 0 & 1 \\
 y & 0 & -2 & -4 & -6 \\
\end{array}
\]

14. 

\[
\begin{array}{c|cccc}
 x & 2 & 4 & 6 & 8 \\
 y & 3 & 5 & 8 & 11 \\
\end{array}
\]

15. 

\[
\begin{array}{c|cccc}
 x & 3 & 6 & 9 & 12 \\
 y & 2 & 4 & 6 & 8 \\
\end{array}
\]
Homework Practice

Linear and Nonlinear Functions

Determine whether each table or equation represents a **linear** or **nonlinear** function. Explain.

1. \( y = 4x^2 \)
2. \( y = 4x + 9 \)
3. \( y = -x^3 + 6 \)
4. \( y = \frac{-2}{3}x + 1 \)

5. \[
\begin{array}{c|cccc}
  x & 1 & 2 & 3 & 4 \\
  y & 10 & 8 & 6 & 4 \\
\end{array}
\]
6. \[
\begin{array}{c|cccc}
  x & 2 & 4 & 6 & 8 \\
  y & -6 & -12 & -18 & -24 \\
\end{array}
\]

7. \[
\begin{array}{c|cccc}
  x & 1 & 2 & 3 & 4 \\
  y & 1 & 4 & 9 & 16 \\
\end{array}
\]
8. \[
\begin{array}{c|cccc}
  x & 1.5 & 3 & 4.5 & 6 \\
  y & 4 & 6 & 8 & 10 \\
\end{array}
\]

9. **MINIMUM WAGE** The graph shows the U.S. minimum wage since 1978. Would you describe the yearly increase as linear or nonlinear? Explain your reasoning.

![U.S. Minimum Wage Graph](image-url)
Problem-Solving Practice

Linear and Nonlinear Functions

1. **EQUILATERAL TRIANGLE** Write a function for the perimeter of an equilateral triangle. Is the perimeter a linear or nonlinear function of one of the side lengths? Explain.

2. **BUSINESS** The I Wire It Company charges $60 for a service call plus $50 per hour for labor. The total charge $C$ can be found using the function $C = 50x + 60$ where $x$ represents the number of hours of labor. Is the total charge a linear or nonlinear function of the number of hours? Explain.

3. **DISTANCE** Buddy’s shoe falls off when he is at the top of a Ferris Wheel. The height $h$ of the shoe after falling for $t$ seconds is given by $h = 200 - 16t^2$. Is the height of the shoe a linear or nonlinear function of the time it falls? Explain.

4. **DRIVING** The table shows the cost of a speeding ticket as a function of the speed over the limit. Is the cost a linear or nonlinear function? Explain.

<table>
<thead>
<tr>
<th>Speed (mph) Over Limit</th>
<th>5</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td>30</td>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>

5. **LONG DISTANCE** The table shows the charge for a long distance call as a function of the length of the call. Is the charge a linear or nonlinear function of the number of minutes? Explain.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td>0.75</td>
<td>1.50</td>
<td>2.25</td>
<td>3.00</td>
</tr>
</tbody>
</table>

6. **BOOKS** The library calculates the fine on an overdue book using the equation $f = 0.25d$ where $d$ is the number of days the book is overdue. Is the fine a linear or nonlinear function of the number of days? Explain.
Enrich

Quadratic Functions of the Form \( y = x^2 + c \) or \( y = -x^2 + c \)

A quadratic function is a function where the power of \( x \) is 2. The general equation is \( y = ax^2 + bx + c \), where \( a \neq 0 \). The graph of a quadratic function is a parabola. The vertex is the point where the graph turns. It is the highest or lowest point on the parabola.

**Example**

Graph \( y = x^2 + 4 \).

**Step 1** Make a table of values.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( x^2 + 4 )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>((-2)^2 + 4)</td>
<td>8</td>
</tr>
<tr>
<td>-1</td>
<td>((-1)^2 + 4)</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>(0^2 + 4)</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>(1^2 + 4)</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>(2^2 + 4)</td>
<td>8</td>
</tr>
</tbody>
</table>

The vertex is \((0, 4)\).

**Exercises**

Graph each quadratic function. Find the coordinates of the vertex.

1. \( y = x^2 + 1 \)
2. \( y = x^2 - 2 \)
3. \( y = -x^2 - 3 \)
4. \( y = -x^2 + 5 \)

5. How can you find the coordinates of the vertex from the equation?

6. What determines whether the graph opens up or down?
Reteach
Multiply and Divide Monomials

The Product of Powers Property states that to multiply powers that have the same base, add the exponents: \(a^n \cdot a^m = a^{n+m}\).

### Examples
Multiply. Express using exponents.

1. \(2^3 \cdot 2^2\)
\[
2^3 \cdot 2^2 = 2^{3+2} = 2^5
\]
The common base is 2. Add the exponents.

2. \(-2s^6(-7s^7)\)
\[
-2s^6(-7s^7) = (-2 \cdot -7)(s^6 \cdot s^7) = (14)(s^{6+7}) = 14s^{13}
\]
Commutative and Associative Properties

The Quotient of Powers Property states that to divide powers that have the same base, subtract the exponents: \(a^n \div a^m = a^{n-m}\).

### Examples
Divide. Express using exponents.

3. \(\frac{k^8}{k^6}\)
\[
\frac{k^8}{k^6} = k^{8-6} = k^2
\]
The common base is \(k\). Subtract the exponents.

4. \(\frac{28g^{12}}{-4g^3}\)
\[
\frac{28g^{12}}{-4g^3} = \frac{28}{-4} \cdot \left(\frac{g^{12}}{g^3}\right) = (-7)(g^{12-3}) = -7g^9
\]
Commutative and Associative Properties

### Exercises
Find each product or quotient. Express using exponents.

1. \(3^5 \cdot 3^2\)
2. \(5^2 \cdot 5^6\)
3. \(e^2 \cdot e^4\)
4. \(2a^5 \cdot 3a\)
5. \(-3t^4 \cdot 2t^6\)
6. \(4x^2(4^2x^3)\)
7. \(\frac{2^8}{2^7}\)
8. \(\frac{7^{11}}{7^4}\)
9. \(\frac{v^{14}}{v^9}\)
10. \(\frac{15w^7}{5w^3}\)
11. \(\frac{21z^{12}}{3z^2}\)
12. \(\frac{10m^8}{m^2}\)
Find each product or quotient. Express using exponents.

1. \( 2^7 \cdot 2^3 \)
2. \( 4^2 \cdot 4^5 \)

3. \( 10^4 \cdot 10^5 \)
4. \( k^8 \cdot k^9 \)

5. \( t^6 \cdot t^3 \)
6. \( 2w^3 \cdot 5w^2 \)

7. \( 3e^3 \cdot 6e^4 \)
8. \( -4r^6(4r^3) \)

9. \( (3u^5)(3^3u^6) \)
10. \( (2p^7)(2^3p^2) \)

11. \( \frac{2^9}{2^6} \)
12. \( \frac{3^5}{3} \)

13. \( \frac{5^4}{5^2} \)
14. \( \frac{8^7}{8^4} \)

15. \( \frac{b^{11}}{b^4} \)
16. \( \frac{n^5}{n^3} \)

17. \( \frac{k^4}{k} \)
18. \( \frac{A^{15}}{A^{13}} \)

19. \( \frac{12n^6}{3n^2} \)
20. \( \frac{14m^3}{7m} \)

21. \( \frac{9b^9}{9b^4} \)
22. \( \frac{24t^{10}}{6t^3} \)

23. \( \frac{3v^2}{3v^6} \)
24. \( \frac{x^3 \cdot y^4}{x \cdot y^2} \)
Homework Practice

Multiply and Divide Monomials

Find each product or quotient. Express using exponents.

1. \(5^9 \cdot 5^4\)

2. \(3^8 \cdot 3^7\)

3. \(a \cdot a^4\)

4. \(m^5 \cdot m^2\)

5. \(3x \cdot 4x^6\)

6. \(-5d^4(6d^8)\)

7. \((6k^5)(-k^5)\)

8. \(\left(\frac{3}{7}\right)^2 \left(\frac{3}{7}\right)^3\)

9. \((-4a^5)(6a^3)\)

10. \((2^8a^5)(2^8a^9)\)

11. \(\frac{5^{10}}{5^4}\)

12. \(\frac{8^3}{8}\)

13. \(\frac{b^6}{b^5}\)

14. \(\frac{G^{16}}{G^8}\)

15. \(\frac{18v^5}{3v^3}\)

16. \(\frac{24a^6}{6a^4}\)

17. \(\frac{30s^4}{-5s}\)

18. \(\frac{V^{10}}{V^{21}}\)

19. \(\frac{n^{18}}{2n^{11}}\)

20. \(\frac{a^8 \cdot b^2}{a \cdot b^2}\)

21. **BONUSES** A company has set aside \(10^5\) dollars for holiday employee bonuses. If the company has \(10^3\) employees and the money is divided equally among them, how much will each employee receive?

22. **CAR LOANS** After making a down payment, Mr. Green will make \(7^2\) monthly payments of \(7^3\) dollars each to pay for his new car. What is the total amount paid after the down payment??

For more examples, go to glencoe.com.
### Problem-Solving Practice

#### Multiply and Divide Monomials

1. **BOOKS** A publisher sells $10^5$ copies of a new book. If each book sells for $10, how much will the publisher make? Write your answer using exponents.

2. **TURKEYS** Mrs. Cowgill has $2^5$ female turkeys on her farm. If each turkey lays $2^3$ eggs, how many turkey eggs will she have? Write your answer using exponents.

3. **MONEY** $10^2$ one-dollar bills are equivalent to 1 hundred-dollar bill. How many one-dollar bills are equivalent to $10^6$ hundred-dollar bills? Write your answer using exponents.

4. **WEDDING** A couple is planning a meal for $3^5$ people at their wedding. If they plan to seat $3^2$ people at each table, how many tables do they need? Write your answer using exponents.

5. **COMPUTERS** The table shows the number of bytes in computer memory. How many times as great is a gigabyte than a kilobyte?

<table>
<thead>
<tr>
<th>Memory Term</th>
<th>Number of Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte</td>
<td>$2^0$ or 1</td>
</tr>
<tr>
<td>Kilobyte</td>
<td>$2^{10}$</td>
</tr>
<tr>
<td>Megabyte</td>
<td>$2^{20}$</td>
</tr>
<tr>
<td>Gigabyte</td>
<td>$2^{30}$</td>
</tr>
</tbody>
</table>

6. **SOUND** Sound is measured in decibels. Ordinary conversation is rated at about 60 decibels or a relative loudness of $10^6$. A jet plane taking off is rated at about 110 decibels or a relative loudness of $10^{11}$. How many times as great is the sound of a jet plane taking off than the sound of ordinary conversation?
**Enrich**

**Multiply a Binomial by a Monomial**

A binomial is an expression that consists of the sum or difference of two monomials. To multiply a binomial by a monomial, use the Distributive Property.

\[ a(b + c) = ac + ac \]

**Example 1**
Multiply \( x^3(x^5 + x^3) \).

\[
x^3(x^5 + x^3) = (x^3 \cdot x^5) + (x^3 \cdot x^3) \quad \text{Distributive Property}
\]
\[
= x^8 + x^6 \quad \text{Add exponents.}
\]

**Example 2**
Multiply \( 5x(3x - 8) \).

\[
5x(3x - 8) = (5x \cdot 3x) - (5x \cdot 8) \quad \text{Distributive Property}
\]
\[
= 15x^2 - 40x \quad \text{Simplify.}
\]

**Exercises**

Multiply.

1. \( 2x(4x + 9) \)
2. \( a^2(2a - 1) \)

3. \( b^5(b^3 + b^2) \)
4. \( 5x^2(2x^2 - 3x) \)

5. \( \frac{1}{2} c(10c - 4) \)
6. \( x^2(x + 1) \)

7. \( 6a^4(2a^3 + 3a^2) \)
8. \( -4y^2(6y - 2) \)

9. \( 12k^4(3k^2 + k) \)
10. \( -9x(7x^3 - 8x^2) \)

11. \( -f^3(12 + f) \)
12. \( 3g^3(4g + g^2) \)

13. \( \frac{1}{3} m(9m^2 + 12m^3) \)
14. \( 2n(n^2 - \frac{5}{2n}) \)
Reteach

Negative Exponents

Any nonzero number to the negative $n$ power is the multiplicative inverse of its $n$th power.

$$a^{-n} = \frac{1}{a^n} \text{ for } a \neq 0 \text{ and any integer } n$$

**Example 1** Write $4^{-2}$ using a positive exponent.

$$4^{-2} = \frac{1}{4^2}$$

Definition of negative exponent

**Example 2** Write $\frac{1}{x^5}$ using a negative exponent other than $-1$.

$$\frac{1}{x^6} = x^{-6}$$

Definition of negative exponent

**Example 3** Simplify $x^4 \cdot x^{-7}$.

Method 1 Quotient of Powers

$$x^4 \cdot x^{-7} = x^{4+(-7)} = x^{-3}$$

Method 2 Definition of Power

$$x^4 \cdot x^{-7} = x \cdot x \cdot x \cdot \frac{1}{x \cdot x \cdot x \cdot x \cdot x \cdot x}$$

$$= \frac{x \cdot x \cdot x \cdot x}{x \cdot x \cdot x \cdot x \cdot x \cdot x}$$

$$= x^{-3}$$

**Example 4** Simplify $\frac{a^6}{a^4}$.

Method 1 Quotient of Powers

$$\frac{a^6}{a^4} = a^{6-4}$$

$$= a^2$$

Method 2 Definition of Power

$$\frac{a^6}{a^4} = \frac{a \cdot a \cdot a \cdot a \cdot a \cdot a}{a \cdot a \cdot a \cdot a}$$

$$= a \cdot a$$

$$= a^2$$

**Exercises**

Write each expression using a positive exponent.

1. $5^{-4}$
2. $(-6)^{-7}$
3. $a^{-8}$

Write each expression using a negative exponent other than $-1$.

4. $\frac{1}{5^3}$
5. $\frac{1}{x^4}$
6. $\frac{1}{16}$

Simplify each expression.

7. $a^6 \cdot a^{-5}$
8. $n^{-11} \cdot n^{-2}$
9. $r^7 \div r^3$
Skills Practice
Negative Exponents

Write each expression using a positive exponent.

1. $6^{-2}$
2. $(-5)^{-3}$
3. $m^{-4}$
4. $2^{-1}$
5. $n^{-10}$
6. $b^{-8}$
7. $c^{-3}$
8. $(-a)^{-2}$

Write each expression using a negative exponent other than $-1$.

9. $\frac{1}{3^9}$
10. $\frac{1}{x^4}$
11. $\frac{1}{125}$
12. $\frac{1}{2^4}$
13. $\frac{1}{k^5}$
14. $\frac{1}{36}$
15. $\frac{2}{200}$
16. $\frac{1}{m^5}$

Simplify each expression.

17. $a^4 \cdot a^{-5}$
18. $b^6 \cdot b^{-4}$
19. $c^{-7} \cdot c^{-9}$
20. $2g^6 \cdot 3g^{-2}$
21. $8w^{-5} \cdot 2w^{-4}$
22. $\frac{x^9}{x^7}$
23. $\frac{s^{-11}}{s^{-4}}$
24. $\frac{20b^5}{5b}$
25. $\frac{n^{-8}}{n^{-19}}$
26. $\frac{36m^5}{6m^4}$
27. $\frac{24c^{-4}}{4c^{-2}}$
28. $\frac{30a^{-5}}{6a^{-8}}$
Write each expression using a positive exponent.

1. \(8^{-3}\)  
2. \((-4)^{-5}\)  
3. \(2k^{-4}\)  
4. \((-3)^{-3}\)  
5. \(7^{-2}\)  
6. \(5a^{-3}\)

Write each expression using a negative exponent other than \(-1\).

7. \(\frac{1}{9^3}\)  
8. \(\frac{1}{32}\)  
9. \(\frac{1}{b^7}\)  
10. \(\frac{3}{m^5}\)  
11. \(\frac{n}{100}\)  
12. \(\frac{1}{12^2}\)

Simplify each expression.

13. \(a^{-5} \cdot a^3\)  
14. \(6w^{-5} \cdot 8w^{-3}\)  
15. \(\frac{f^2}{f^4}\)  
16. \(4m^6 \cdot 3m^{-8}\)  
17. \(\frac{81c^{-7}}{9c^{-5}}\)  
18. \(\frac{w^{-9}}{w^{-5}}\)

19. **FRACTIONS** Lorenzo needed to find \(\frac{1}{9}\) of 27. His friend Carla told him to write \(\frac{1}{9}\) as \(3^{-2}\) and 27 as \(3^3\) and multiply \(3^{-2}\) by \(3^3\) to get \(3^{-6}\). Was Carla correct? Explain.

20. **RICE** The mass of a grain of rice is about \(10^{-2}\) grams. About how many grains of rice are in a container holding \(10^4\) grams of rice?
1. **SALT** The mass of a grain of salt is about $10^{-4}$ gram. About how many grains of salt are in a shaker containing $10^3$ grams?

2. **PLANTS** Suppose each potato plant produces $2^4$ potatoes. How many plants do you need to plant to produce $2^{10}$ potatoes?

3. **ACIDITY** For each increase of one in pH level, the acidity of a substance is 10 times greater. The pH level of baking soda is 8 and the pH level of lye is 13. How many times as great is the acidity of lye than baking soda?

4. **AMUSEMENT PARK** Suppose there were $10^6$ visitors to an amusement park last year. If each person bought 10 ride tickets while they were there, how many ride tickets were sold at the park last year?

5. **MOVIE** There are about $10^7$ bytes of data in a single frame of a movie. How many bytes of data would there be in 1,000 frames of the movie?

6. **FISH** The table shows the number of eggs laid by 2 different varieties of fish during a year. About how many eggs will $10^3$ herrings lay?

<table>
<thead>
<tr>
<th>Fish</th>
<th>Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sturgeon</td>
<td>$10^5$</td>
</tr>
<tr>
<td>Herring</td>
<td>$10^4$</td>
</tr>
</tbody>
</table>
Fractional Exponents

A fractional exponent is the equivalent of a root. A number raised to the $\frac{1}{2}$ power is the same as the square root of the number.

$x^{\frac{1}{2}} = \sqrt{x}$

$x^{\frac{2}{3}} = \sqrt[3]{x}$ or $(\sqrt[3]{x})^2$

### Examples

**Simplify each expression.**

1. $25^{\frac{1}{2}}$
   
   $25^{\frac{1}{2}} = \sqrt{25}$
   
   $= 5$
   
   Definition of fractional power
   
   Simplify.

2. $a^{\frac{1}{3}} \cdot a^{\frac{3}{2}}$
   
   $a^{\frac{1}{3}} \cdot a^{\frac{3}{2}} = a^{\frac{1}{2}}$
   
   $= a^{\frac{2}{2}}$
   
   Add exponents.
   
   Simplify.

3. $4^{\frac{3}{2}}$
   
   $4^{\frac{3}{2}} = \sqrt[2]{4^3}$
   
   $= \sqrt[2]{64}$
   
   Definition of fractional power
   
   Simplify square root.
   
   $= 8$
   
   Simplify.

### Exercises

**Simplify each expression.**

1. $16^{\frac{1}{2}}$
2. $36^{\frac{3}{2}}$
3. $9^{\frac{5}{2}}$
4. $a^{\frac{3}{5}} \cdot a^{\frac{2}{5}}$
5. $b^{\frac{2}{3}} \cdot b^{\frac{4}{3}}$
6. $\frac{49^{\frac{1}{2}}}{49^{\frac{1}{2}}}$
7. $\frac{5^{\frac{3}{2}}}{5^{\frac{3}{3}}}$
8. $27^{\frac{1}{3}}$
9. $8^{\frac{2}{3}}$
10. $\frac{5^{\frac{26}{6}}}{5^{\frac{14}{6}}}$
11. $256^{\frac{1}{4}}$
12. $x^{\frac{16}{7}} \cdot x^{\frac{5}{7}}$
Scientific Notation

A number in scientific notation is written as the product of a factor that is at least one but less than ten and a power of ten.

**Example 1** Express $8.65 \times 10^7$ in standard form.

$8.65 \times 10^7 = 8.65 \times 10,000,000$

$= 86,500,000$

Move the decimal point 7 places to the right.

**Example 2** Express $9.2 \times 10^{-3}$ in standard form.

$9.2 \times 10^{-3} = 9.2 \times \frac{1}{10^3}$

$= 9.2 \times 0.001$

$= 0.0092$

Move the decimal point 3 places to the left.

**Example 3** Express 76,250 in scientific notation.

$76,250 = 7.625 \times 10,000$

The decimal point moves 4 places.

$= 7.625 \times 10^4$

The exponent is positive.

**Example 4** Express 0.00157 in scientific notation.

$0.00157 = 1.57 \times 0.001$

The decimal point moves 3 places.

$= 1.57 \times 10^{-3}$

The exponent is negative.

**Exercises**

Express each number in standard form.

1. $8.2 \times 10^1$

2. $1.9 \times 10^3$

3. $6.48 \times 10^5$

4. $3.7 \times 10^{-3}$

5. $2.36 \times 10^{-2}$

6. $7.1 \times 10^{-6}$

Express each number in scientific notation.

7. 342

8. 29

9. 72,300,000

10. 0.35

11. 0.081

12. 0.00048
Express each number in standard form.

1. $9.2 \times 10^1$
2. $7.9 \times 10^4$
3. $8.3 \times 10^3$
4. $6.8 \times 10^2$
5. $4.06 \times 10^5$
6. $2.91 \times 10^7$
7. $4.35 \times 10^{-1}$
8. $1.7 \times 10^{-6}$
9. $5.6 \times 10^{-7}$
10. $5.03 \times 10^{-4}$
11. $8.99 \times 10^{-3}$
12. $6.2975 \times 10^{-2}$
13. $3.7 \times 10^4$
14. $1.025 \times 10^5$

Express each number in scientific notation.

15. 86
16. 772
17. 25,200
18. 3,941
19. 3,586,000
20. 12,570,900
21. 0.048
22. 0.35
23. 0.000027
24. 0.00062
25. 0.014
26. 0.00857
27. 904
28. 0.02
Express each number in standard form.

1. \(6.42 \times 10^{2}\)  
2. \(2.78 \times 10^{3}\)  
3. \(2.357 \times 10^{5}\)  
4. \(5.09 \times 10^{6}\)  

5. \(3.6 \times 10^{-2}\)  
6. \(5.1 \times 10^{-5}\)  
7. \(9.82 \times 10^{-4}\)  
8. \(3.42 \times 10^{-3}\)  

Express each number in scientific notation.

9. 356  
10. 42,000  
11. 8,350,000  
12. 200,000  

13. 0.11  
14. 0.086  
15. 0.000712  
16. 0.0094  

17. Which number is greater: \(9.3 \times 10^4\) or \(6.8 \times 10^6\)?  
18. Which number is less: \(2.1 \times 10^6\) or \(8.7 \times 10^5\)?  

19. **POPULATION** The table lists the populations of five countries. List the countries from least to greatest population.

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>(2.0 \times 10^7)</td>
</tr>
<tr>
<td>Brazil</td>
<td>(1.9 \times 10^8)</td>
</tr>
<tr>
<td>Egypt</td>
<td>(7.7 \times 10^7)</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>(4.7 \times 10^5)</td>
</tr>
<tr>
<td>Singapore</td>
<td>(4.4 \times 10^6)</td>
</tr>
</tbody>
</table>

20. **SOLAR SYSTEM** Saturn is \(1.43 \times 10^9\) kilometer from the Sun. Write this number in standard form.

21. **MEASUREMENT** One cubic centimeter is about 0.061 inch\(^3\). Write this number in scientific notation.

22. **DISASTERS** In 1992, Hurricane Andrew caused over \$25 billion in damage in Florida. Write \$25 billion in scientific notation.

For more examples, go to glencoe.com.
1. MEASUREMENT  There are about $1.89 \times 10^{-4}$ miles in a foot. Write this number in standard notation.

2. SPACE  The distance from Earth to Alpha Centauri is about $2.5 \times 10^{13}$ miles. Write this number in standard notation.

3. NATIONAL DEBT  The national debt of the United States in 2008 was about $34,500 per person. Write this number in scientific notation.

4. EARTH  The age of Earth is about $4.6 \times 10^9$ years. Write this number in standard notation.

5. PHYSICS  The speed of sound is about $1.1 \times 10^3$ feet per second. Write this number in standard notation.

6. ATOM  The mass of a sodium atom is about $0.0000000157$ centimeters. Write this number in scientific notation.

7. CONCERT TOURS  The table gives three top-grossing North American Concert tours. Write the total gross for Band A’s tour in scientific notation.

<table>
<thead>
<tr>
<th>Band</th>
<th>Total Gross (million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>162</td>
</tr>
<tr>
<td>B</td>
<td>138.9</td>
</tr>
<tr>
<td>C</td>
<td>92.5</td>
</tr>
</tbody>
</table>

8. MILITARY  In 2007 there were about $5.1 \times 10^5$ U.S. Army personnel on active duty. Write this number in standard notation.
When performing operations with numbers in scientific notation, it is often helpful to consider the decimal part and the power of ten separately.

\[(2.3 \times 10^3) (1.4 \times 10^2) = (2.3 \times 1.4) \times (10^3 \times 10^2)\]

\[= 3.22 \times (10 \times 10 \times 10) \times (10 \times 10)\]

\[= 3.22 \times 10^5\]

### Planet Maximum Distance from Sun (miles)

<table>
<thead>
<tr>
<th>Planet</th>
<th>Maximum Distance from Sun (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>(4.34 \times 10^7)</td>
</tr>
<tr>
<td>Venus</td>
<td>(6.77 \times 10^7)</td>
</tr>
<tr>
<td>Earth</td>
<td>(9.45 \times 10^7)</td>
</tr>
<tr>
<td>Mars</td>
<td>(1.55 \times 10^8)</td>
</tr>
<tr>
<td>Jupiter</td>
<td>(5.07 \times 10^8)</td>
</tr>
<tr>
<td>Saturn</td>
<td>(9.41 \times 10^8)</td>
</tr>
<tr>
<td>Uranus</td>
<td>(1.87 \times 10^9)</td>
</tr>
<tr>
<td>Neptune</td>
<td>(2.82 \times 10^9)</td>
</tr>
</tbody>
</table>

### Star Distance from Earth (light-years)

<table>
<thead>
<tr>
<th>Star</th>
<th>Distance from Earth (light-years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Centauri</td>
<td>(4.27)</td>
</tr>
<tr>
<td>Sirius</td>
<td>(8.7)</td>
</tr>
<tr>
<td>Betelgeuse</td>
<td>(520)</td>
</tr>
<tr>
<td>Deneb</td>
<td>(1,600)</td>
</tr>
</tbody>
</table>

### Exercises

Use the information and tables above to answer Exercises 1–6.

1. How long does it take a photon of light to travel from the Sun to Earth?

2. How long does it take a photon of light to travel from the Sun to Mercury?

3. How long does it take a photon of light to travel from the Sun to Neptune?

4. How far is Alpha Centauri from Earth in miles?

5. Deneb is about how many times as far from Earth as Sirius?

6. If you see Betelgeuse, how long ago was that light emitted from the star?
1. Write about one new thing you learned in the chapter.

2. Create a problem with data that can be expressed as an inequality. Solve the inequality.

3. Identify one place you would use scientific notation in the real world. Explain how scientific notation is used.