Lesson 1 Homework Practice

Powers and Exponents

Write each product using an exponent.

1. \(20 \times 20\)
2. \(4 \times 4 \times 4 \times 4\)
3. \(2 \times 2 \times 2 \times 2 \times 2 \times 2\)

4. \(3 \times 3 \times 3 \times 3 \times 3\)
5. \(10 \times 10 \times 10\)
6. \(7 \times 7 \times 7 \times 7 \times 7 \times 7\)

7. \(25 \times 25 \times 25\)
8. \(5 \times 5 \times 5 \times 5 \times 5 \times 5\)
9. \(6.5 \times 6.5\)

10. **SUN** The surface temperature of the sun is close to \(10 \times 10 \times 10 \times 10\) degrees Fahrenheit. Write this product using an exponent.

11. **BONES** There are about \(6 \times 6 \times 6\) bones in the adult human body. Write this product using an exponent.

Write each power as a product of the same factor. Then find the value.

12. \(15^3\)
13. \(6^5\)

14. \(0^4\)
15. \(7^4\)

16. \(5^5\)
17. \(1^8\)

18. \(3.5^2\)
19. \(2.5^3\)

20. **NEWSPAPERS** Tamika delivered \(50^2\) newspapers last summer. Write \(50^2\) as a product of the same factor. Then find the value.

21. **POPULATION** One of the world’s smallest countries, Vatican City, has a population less than \(10^3\) people. About how many people live in this country?
Lesson 1 Skills Practice

Powers and Exponents

Write each product using an exponent.

1. \(5 \times 5 \times 5\)  
2. \(10 \times 10\)  
3. \(6 \times 6 \times 6 \times 6\)

4. \(8 \times 8 \times 8 \times 8 \times 8\)  
5. \(29 \times 29 \times 29 \times 29\)  
6. \(3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3\)

7. \(15 \times 15 \times 15 \times 15\)  
8. \(7 \times 7 \times 7 \times 7 \times 7\)  
9. \(0.2 \times 0.2 \times 0.2\)

10. BUILDINGS The Willis Tower in Chicago is one of the tallest buildings in the world. It stands about \(38 \times 38\) feet tall. Write this product using an exponent.

11. WETLANDS There are about \(10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10\) acres of wetlands left in the lower 48 states. Write this product using an exponent.

Write each power as a product of the same factor. Then find the value.

12. \(3^5\)  
13. \(12^2\)

14. \(6^3\)  
15. \(4^6\)

16. \(10^4\)  
17. \(2^6\)

18. \(5.4^3\)  
19. \(6.9^2\)

20. MONEY Kyra’s school earned \(4^6\) dollars from the annual fundraiser. How much money did the school earn?

21. EARTH The Earth’s diameter is just under \(20^3\) miles. Write \(20^3\) as a product of the same factor. Then find the value.

22. REPTILES The world’s largest reptile, the saltwater crocodile, weighs an average of a little over \(4^5\) pounds. What is this weight written without an exponent?
Lesson 1 Extra Practice

Powers and Exponents

Write each product using an exponent.

1. \(4 \times 4 \times 4 \times 4\)  
2. \(10 \times 10 \times 10\)  
3. \(14 \times 14\)

4. \(3 \times 3 \times 3 \times 3\)  
5. \(2 \times 2 \times 2\)  
6. \(6 \times 6 \times 6 \times 6 \times 6\)

7. \(8.2 \times 8.2 \times 8.2\)  
8. \(7 \times 7 \times 7 \times 7 \times 7 \times 7\)  
9. \(9.5 \times 9.5 \times 9.5\)

Write each power as a product of the same factor. Then find the value.

10. \(9^4\)  
11. \(2^3\)  
12. \(3^5\)

13. \(4^3\)  
14. \(6^5\)  
15. \(5^4\)

16. \(8.5^3\)  
17. \(1.3^2\)  
18. \(7^4\)

19. The number of Calories in a small banana can be written as \(2^7\). What whole number does \(2^7\) represent?
## Lesson 1 Problem-Solving Practice

### Powers and Exponents

1. **OLYMPICS** The first Olympics were held in Greece more than \(7 \times 7 \times 7 \times 7\) years ago. Write this product using an exponent. Then find its value.

2. **RIDES** The fastest roller coaster in the world is located in New Jersey. It travels \(2^7\) miles per hour. Write \(2^7\) as a product of the same factor. Then find the value.

3. **BASEBALL** With a total of more than \(3^6\) home runs, Barry Bonds holds the major league record for the most home runs. About how many home runs did Barry Bonds have?

4. **PLANETS** The table shows facts and data about the planets. Write each exponent as a product of the same factor. Then find each value.

   | Diameter of the moon (mi) | \(3^7\) |
   | Diameter of largest planet, Jupiter (mi) | \(17^4\) |
   | Hottest planet, Venus (°F) | \(29^2\) |
   | Coldest planet, Pluto (°F) | \(7^3\) |

5. **STATES** The table shows the approximate area of the largest and smallest states in the United States.

<table>
<thead>
<tr>
<th>State</th>
<th>Area (mi(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>(87^3)</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>(39^2)</td>
</tr>
</tbody>
</table>

   Write each power as a product of the same factor. Then find the value.

6. **PARKS** Yellowstone National Park is known for its \(10^4\) hot springs and geysers, which is more than anywhere else in the world. Write \(10^4\) as a product of the same factor. How many hot springs and geysers are in Yellowstone National Park?
Exponential Patterns

The table below lists consecutive powers of 3, 5, and 10. Once completed, the table can identify patterns found in the values of these powers.

<table>
<thead>
<tr>
<th>Powers of 3</th>
<th>Powers of 5</th>
<th>Powers of 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3^0 = $</td>
<td>$5^0 = $</td>
<td>$10^0 = $</td>
</tr>
<tr>
<td>$3^1 = $</td>
<td>$5^1 = $</td>
<td>$10^1 = $</td>
</tr>
<tr>
<td>$3^2 = $</td>
<td>$5^2 = $</td>
<td>$10^2 = $</td>
</tr>
<tr>
<td>$3^3 = $</td>
<td>$5^3 = $</td>
<td>$10^3 = $</td>
</tr>
</tbody>
</table>

Exercises

For Exercises 1–5, use the table shown above.

1. Copy and complete the table.

2. Describe the pattern for the powers of 3. Find the value of $3^0$.

3. Describe the pattern for the powers of 5. Find the value of $5^0$.

4. Describe the pattern for the powers of 10. Find the value of $10^0$.

5. Extend the pattern for the powers of $10^5$ and $10^6$. How can you easily write the value of any power of 10?
Lesson 2 Homework Practice

Numerical Expressions

Find the value of each expression.

1. $34 + 17 - 5$
2. $25 - 14 + 3$
3. $42 + 6 ÷ 2$

4. $39 \times (15 ÷ 3) - 16$
5. $48 ÷ 8 + 5 \times (7 - 2)$
6. $64 ÷ (15 - 7) \times 2 - 9$

7. $(3 + 7) \times 6 + 4$
8. $9 + 8 \times 3 - (5 \times 2)$
9. $7^2 + 6 \times 2$

10. $34 - 8^2 ÷ 4$
11. $45 ÷ 3 \times 2^3$
12. $4 \times (5^2 - 12) - 6$

13. $78 - 2^4 ÷ (14 - 6) \times 2$
14. $9 + 7 \times (15 + 3) ÷ 3^2$
15. $13 + (4^3 ÷ 2) \times 5 - 17$

16. ART An art supply store sells posters for $9 each and picture frames for $15 each.
   
a. Write an expression for the total cost of 6 posters and 6 frames.

b. What is the total cost for 6 framed posters?

17. SCIENCE There are 24 students in a science class. Mr. Sato will give each pair of students 3 magnets. So far, Mr. Sato has given 9 pairs of students their 3 magnets. How many more magnets does Mr. Sato need so that each pair of students has exactly 3 magnets?
Lesson 2 Skills Practice

Numerical Expressions

Find the value of each expression.

1. $7 - 6 + 5$
2. $31 + 19 - 8$

3. $64 - 8 + 21$
4. $17 + 34 - 2$

5. $28 + (89 - 67)$
6. $(8 + 1) \times 12 - 13$

7. $63 \div 9 + 8$
8. $5 \times 6 - (9 - 4)$

9. $13 \times 4 - 72 \div 8$
10. $16 \div 2 + 8 \times 3$

11. $30 \div (21 - 6) \times 4$
12. $6 \times 7 \div (6 + 8)$

13. $88 - 16 \times 5 + 2 - 3$
14. $(2 + 6) \div 2 + 4 \times 3$

15. $4^3 - 24 \div 8$
16. $100 \div 5^2 \times 4^3$
Lesson 2 Extra Practice

Numerical Expressions

Find the value of each expression.

1. $14 - 5 + 7$
2. $12 + 10 - 5 - 6$
3. $50 - 6 + 12 + 4$

4. $12 - 2 \times 3$
5. $16 + 4 \times 5$
6. $5 + 3 \times 4 - 7$

7. $2 \times 3 + 9 \times 2$
8. $6 \times 8 + 4 \div 2$
9. $7 \times 6 - 14$

10. $8 + 12 \times 4 + 8$
11. $13 - 6 \times 2 + 1$
12. $80 + 10 \times 8$

13. $14 - 2 \times 7 + 0$
14. $156 - 6 \times 0$
15. $30 - 14 \times 2 + 8$

16. $54 + (8 - 5)$
17. $4^2 + 3^3$
18. $(11 - 7) \times 3 - 5$

19. $25 - 9 + 4$
20. $100 + 10 \times 2$
21. $3 \times 4^3$

22. $11 + 4 \times (12 - 7)$
23. $6^2 - 7 \times 4$
24. $12 + 5^2 - 9$
Lesson 2 Problem-Solving Practice

Numerical Expressions

MONEY For Exercises 1–3, use the table that shows the price of admission to a movie theater.

<table>
<thead>
<tr>
<th>Movie Theater Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults: $8</td>
</tr>
<tr>
<td>Children (under 13): $5</td>
</tr>
<tr>
<td>Matinee (before 6 P.M.): $3</td>
</tr>
</tbody>
</table>

1. Janelle (age 12) and her cousin, Marquita (age 14), go to a 7:00 P.M. show. Write an expression for the total cost of admission. What is the total cost?

2. Jan takes her three children and two neighbor’s children to a matinee. All of the children are under age 13. Write an expression for the total cost of admission. How much in all did Jan pay for admission?

3. Connor (age 13), his sister (age 7), and Connor’s parents go to a movie on Saturday night. Write an expression for the total cost. What is the total cost?

4. SOCCER Eduardo is 16 years old. Eduardo’s dad takes him and his younger sister to a soccer match. Tickets are $17 for adults and $13 for children (18 and under). Write an expression for the total cost of the tickets. What is the total cost of the tickets?

5. MONEY Frankie orders two hamburgers and a soda for lunch. A hamburger is $3 and a soda is $1. Write an expression to show how much he paid for lunch. Then find the value of the expression.

6. MONEY A store sells barrettes for $2 each and combs for $1. Shelby buys 3 barrettes and a comb. Ashley buys 2 barrettes and 4 combs. Write an expression for the amount the two girls spent all together. Find the total amount spent.
Operations Puzzles

Now that you have learned how to evaluate an expression using the order of operations, can you work backward? In this activity, the value of the expression is given. It is your job to decide what operations or numbers must be in order to arrive at that value.

Fill in each □ with +, −, ×, or ÷ to make a true statement.

1. \( 48 □ 3 □ 12 = 12 \)  
2. \( 30 □ 15 □ 3 = 6 \)

3. \( 24 □ 12 □ 6 □ 3 = 4 \)  
4. \( 24 □ 12 □ 6 □ 3 = 18 \)

5. \( 4 □ 16 □ 2 □ 8 = 24 \)  
6. \( 45 □ 3 □ 3 □ 9 = 3 \)

7. \( 36 □ 2 □ 3 □ 12 □ 2 = 0 \)  
8. \( 72 □ 12 □ 4 □ 8 □ 3 = 0 \)

Fill in each □ with one of the given numbers to make a true statement. Each number may be used only once.

9. \( 6, 12, 24 \)  
10. \( 4, 9, 36 \)  
\[ \square ÷ \square × \square = 12 \]  
\[ \square × \square − \square = 0 \]

11. \( 6, 8, 12, 24 \)  
12. \( 2, 5, 10, 50 \)  
\[ \square ÷ \square + \square − \square = 4 \]  
\[ \square ÷ \square − \square + \square = 50 \]

13. \( 2, 4, 6, 8, 10 \)  
14. \( 1, 3, 5, 7, 9 \)  
\[ \square ÷ \square × \square + \square − \square = 0 \]  
\[ \square ÷ \square + \square − \square ÷ \square = 1 \]

15. CHALLENGE Fill in each □ with one of the digits from 1 through 9 to make a true statement. Each digit may be used only once.
\[ \square ÷ \square × \square + \square × \square × \square ÷ \square + \square × \square = 100 \]
Lesson 3 Homework Practice

Algebra: Variables and Expressions

Evaluate each expression if $m = 6$ and $n = 12$.

1. $m + 5$
2. $n - 7$
3. $m \cdot 4$
4. $m + n$

5. $n - m$
6. $12 \div n$
7. $9 \cdot n$
8. $n \div m$

9. $2m + 5$
10. $4m - 17$
11. $36 - 6m$
12. $3n + 8$

Evaluate each expression if $a = 9$, $b = 3$, and $c = \frac{1}{3}$.

13. $a^2 \div 3$
14. $15b + a^2$
15. $b^2 + 4 \cdot 6$

16. $a^2 - 2b^2$
17. $a^2 + 30 - 18$
18. $b^2 + 5a - 20$

19. $b^3 + c$
20. $19 + 6a \div 2$
21. $4b^2 \cdot 3$

22. $3c \div (2b^2)$
23. $a^2 - (3c)$
24. $ac \div (2b)$

25. ANIMALS A Gentoo penguin can swim at a rate of 17 miles per hour. How many miles can a penguin swim in 4 hours? Use the expression $rt$, where $r$ represents rate and $t$ represents time.

26. CLOTHING A company charges $6 to make a pattern for an order of T-shirts and $11 for each T-shirt it produces from the pattern. The expression $11n + 6$ represents the cost of $n$ T-shirts with the same pattern. Find the total cost for 5 T-shirts with the same pattern.
Lesson 3 Skills Practice

Algebra: Variables and Expressions

Complete the table.

<table>
<thead>
<tr>
<th>Algebraic Expressions</th>
<th>Variables</th>
<th>Numbers</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (5d + 2c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. (5w - 4y + 2s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. (xy ÷ 4 + 3m - 6)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Evaluate each expression if \(a = 3\) and \(b = 4\).

4. \(10 + b\)  
5. \(2a + 8\)  
6. \(4b - 5a\)

7. \(a \cdot b\)  
8. \(7a \cdot 9b\)  
9. \(8a - 9\)

10. \(b \cdot 22\)  
11. \(a^2 + 1\)  
12. \(18 ÷ 2a\)

13. \(a^2 \cdot b^2\)  
14. \(ab ÷ 3\)  
15. \(15a - 4b\)

16. \(ab + 7 \cdot 11\)  
17. \(36 ÷ 6a\)  
18. \(7a + 8b \cdot 2\)

Evaluate each expression if \(x = 7, y = \frac{1}{2}\), and \(z = 8\).

19. \(x + y + z\)  
20. \(x + 2z\)  
21. \(4y\)

22. \(4x - 3z\)  
23. \(4x - 17\)  
24. \(6z - 5z\)

25. \(9y + (2x + 1)\)  
26. \(14 + 2z\)  
27. \(z ÷ 2\)

28. \(xz\)  
29. \(y - x\)  
30. \(24y - z\)

31. \(xz - 2y + 8\)  
32. \(2xz\)  
33. \(30y \cdot 40x - 1,000\)
Lesson 3 Extra Practice

Algebra: Variables and Expressions

Evaluate each expression if \( m = 2 \) and \( n = 4 \).

1. \( m + m \)
2. \( n - m \)
3. \( mn \)

4. \( 3m + 5 \)
5. \( 2n + 2m \)
6. \( m \cdot 0 \)

7. \( 64 + n \)
8. \( 12 - m \)
9. \( 5n + m \)

10. \( 6mn \)
11. \( 4n - 3 \)
12. \( n + m + 8 \)

Evaluate each expression if \( a = 3 \), \( b = 4 \), and \( c = 12 \).

13. \( a + b \)
14. \( c - a \)
15. \( a + b + c \)

16. \( b - a \)
17. \( c - a \cdot b \)
18. \( a + 2 \cdot b \)

19. \( b + c + 2 \)
20. \( ab \)
21. \( 25 + c + b \)

22. \( c + a + 10 \)
23. \( 2b - a \)
24. \( 2ab \)
Lesson 3 Problem-Solving Practice

Algebra: Variables and Expressions

TRAVEL For Exercises 1 and 2, use the table that shows the distances between several cities.

<table>
<thead>
<tr>
<th>Mileage Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Greenville</td>
</tr>
<tr>
<td>Clinton</td>
</tr>
<tr>
<td>Franklin</td>
</tr>
<tr>
<td>Springfield</td>
</tr>
</tbody>
</table>

1. To find the speed of a car, use the expression \( d \div t \), where \( d \) represents the distance and \( t \) represents time. Find the speed of a car that travels from Clinton to Greenville in 2 hours.

2. To find the time it will take for a train to travel from Springfield to Franklin, use the expression \( d/s \), where \( d \) represents distance and \( s \) represents speed. Find the time if the train travels at a speed of 79 miles per hour.

3. PERIMETER The perimeter of a rectangle can be found using the expression \( 2l + 2w \), where \( l \) represents the length and \( w \) represents the width. Find the perimeter if \( l = 6 \) units and \( w = 3 \) units.

4. PERIMETER Another expression for perimeter is \( 2(l + w) \). Find the perimeter of the rectangle in Exercise 3 using this expression. How do the answers compare? Explain how you used order of operations using this expression.

5. SHOPPING The expression \( 3j + 10 \) shows the total cost with shipping for 3 pairs of jeans. Find the total cost if each pair of jeans costs $25.

6. SHOPPING The expression \( 15p + 12r \) shows the total cost of buying \( p \) printed shirts and \( r \) plain shirts. Find the total cost if you buy two printed shirts and three plain shirts.
Using Formulas

A formula is an equation that can be used to solve certain kinds of problems. Formulas often have algebraic expressions. Below are some common formulas used to solve geometry problems. The variables in geometric formulas represent dimensions of the geometric figures.

**Area** $(A)$
- of a rectangle: $A = \ell \cdot w$
- of a square: $A = s^2$
- of a triangle: $A = \frac{1}{2} bh$

**Volume** $(V)$
- of a rectangular prism: $V = \ell \cdot w \cdot h$

**Perimeter** $(P)$
- of a square: $P = 4s$
- of a rectangle: $P = 2(w + \ell)$

$b =$ base $\quad h =$ height $\quad \ell =$ length $\quad s =$ side $\quad w =$ width

**Write the formula used to solve each problem.**

1. Nate wants to put a fence around his garden to keep rabbits out. Nate’s garden is square in shape. Which formula can Nate use to find how much fence he needs to buy?

2. Dayami’s mother will replace the carpeting in their living room. The living room is rectangular in shape. Which formula can Dayami’s mother use to determine how much carpeting she will need to order for her living room?

3. Victor is cleaning his aquarium, which is shaped like a rectangular prism. After he empties the aquarium and cleans the sides, he will refill the aquarium. Which formula can Victor use to determine how much water he will put back in the aquarium?

4. Guliana is making a triangular flag for a school project. Which formula can she use to determine how much material she needs to buy to make the flag?

**Solve each problem.**

5. A tablecloth is 8 feet long and 5 feet wide. What is the area of the tablecloth?

6. Victoria wants to frame a square picture that has sides of 6 inches. How many inches of wood will she need to make the frame?

7. How many cubic centimeters of packing peanuts will fit in a cardboard box that is 9 centimeters long, 8 centimeters wide, and 3 centimeters high?

8. Joaquin paints a mural on one wall of the school’s gymnasium. Part of the mural is a triangle with a base of 20 feet and a height of 8 feet. What is the area of the triangle?
Lesson 4 Homework Practice

Algebra: Write Expressions

Define a variable. Then write each phrase as an algebraic expression.

1. nine less than a number

2. five times the number of books in the library

3. three more pancakes than his brother ate

4. two more than seven times Lynn’s age

5. 9 minutes less than Frances’ time

6. SPORTS The distance around a basketball, or circumference, is about three times the circumference of a softball. Define a variable and write an expression to represent the circumference of a basketball.

7. PLUMBING A plumber charges $50 to visit a house plus $40 for every hour of work. Define a variable and write an expression to represent the total cost of hiring a plumber.

8. CAMPING A camp leader figures that she needs one tent for every three campers, plus a tent for herself. Define a variable and write an expression to represent the number of tents needed.
Lesson 4 Skills Practice

Algebra: Write Expressions

Define a variable. Then write each phrase as an algebraic expression.

1. one more ball than is on the playground

2. three more cookies than are in the jar

3. twelve fewer questions than were on the first test

4. eight dollars more than the shirt costs

5. three times as many drinks on the tray

6. five dollars less than Yumi’s pay

7. The English class has half as many students as the math class.

8. one third of Emily’s age

9. ten times the minutes spent exercising

10. MAIL Spencer bought 3 books of stamps and mailed a package. It cost $4.50 to mail the package. Define a variable and write an expression to represent the total amount he spent at the post office.
Lesson 4 Extra Practice

Algebra: Write Expressions

Define a variable and write each phrase as an algebraic expression.

1. seven feet more than the height
   
   \[ h + 7 \]

2. twice the number of exercises
   
   \[ 2e \]

3. three times as many DVDs
   
   \[ 3d \]

4. two years less than Carlos’s age
   
   \[ a - 2 \]

5. Ray rode four miles less than Carole.
   
   \[ m - 4 \]

6. Nestor exercised for 12 minutes more than Clare.
   
   \[ m + 12 \]

7. The distance to the library is twice as many blocks as the distance to the theater.
   
   \[ 2b \]

8. Carisa is four inches taller than her friend Lily.
   
   \[ l + 4 \]
Lesson 4 Problem-Solving Practice

Algebra: Write Expressions

OLYMPICS For Exercises 1–4, use the table that shows the number of medals won by each country in the 2008 Summer Olympics.

<table>
<thead>
<tr>
<th>Country</th>
<th>Medals</th>
<th>Country</th>
<th>Medals</th>
<th>Country</th>
<th>Medals</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>$m$</td>
<td>Great Britain</td>
<td>47</td>
<td>France</td>
<td>40</td>
</tr>
<tr>
<td>China</td>
<td>100</td>
<td>Australia</td>
<td>$a$</td>
<td>South Korea</td>
<td>31</td>
</tr>
<tr>
<td>Russia</td>
<td>72</td>
<td>Germany</td>
<td>41</td>
<td>Italy</td>
<td>$i$</td>
</tr>
</tbody>
</table>

1. Write an expression to show how many more medals the USA won than Germany.

2. Write an expression to show how many fewer medals Australia won than Great Britain.

3. Write an expression to show how many medals were won by the USA, Australia, and France combined.

4. The number of medals won by the United States is 26 more than three times the number of medals won by Italy. Write an algebraic expression to represent this statement.

5. TRAVEL Mrs. Guang purchased four airline tickets to Florida. She will also pay a fee of $55 for an extra piece of luggage. Define a variable and write an expression to represent her total cost of flying to Florida.

6. MEASUREMENT There are about 1.6 kilometers in every mile. Write an expression to represent the approximate number of kilometers in $m$ miles. Then use the expression to find the approximate number of kilometers in 5 miles.
Combining Expressions

If you have more than one expression with the same variable, you can combine them to form a new expression. You use a coefficient to show how many times the variable is used. The coefficient is written before the variable.

Add $x + 8$ and $x + 15$.

1. Write a plus sign between the two expressions.
2. Reorder the addends.
3. Add the variables. Since there are two $x$s, write a coefficient of 2.
4. Add the remaining numbers.

$2x + 23$

---

**Exercises**

Add the expressions. Show your work.

1. $t + 10$ and $t + 20$
2. $y + 3$ and $y + 16$

2$t + 30$

2$t + 19$

3. $d + 4$ and $d + 82$
4. $w + 17$ and $w + 22$

2$d + 86$

2$w + 39$

5. $m + 6$ and $m + 14$ and $m + 31$
6. $c + 5$ and $c$

3$m + 51$

2$c + 5$

7. $g + 26$ and $g + 20$ and $g$
8. $p + 11$ and $14$ and $p$

3$g + 46$

2$p + 25$
Homework Practice

Problem-Solving Investigation: Act It Out

Mixed Problem Solving

Use the act it out strategy to solve Exercises 1 and 2.

1. FITNESS Brad jumps 4 feet forward and then 2 feet backward. How many full sets must he jump to reach 16 feet?

2. SEWING Dion’s grandmother is making a quilt using four small squares put together to form one large square block. How many different blocks can she make using one each of red, green, blue, and yellow small squares? Show the possible arrangements.

Use any strategy to solve Exercises 3–6.

3. ANIMALS Nine birds are sitting on a power line. Three more birds arrive at the same time five of the birds fly off. How many birds are sitting on the power line now?

4. MONEY Clarence bought a pair of running shoes for $7 less than the regular price. If he paid $29, what was the regular price?

5. FOOD Elena bought three bags of dried fruit that weighed $1 \frac{7}{10}$ pounds, $3 \frac{1}{4}$ pounds, and $2 \frac{3}{5}$ pounds. About how much fruit did she buy?

6. PATTERNS What number is missing in the pattern below?

   \[ \ldots, 654, 533, \square, 291, \ldots \]

7. PARTIES Fourteen friends are at a party. Five more friends arrive at the same time that three friends leave. How many friends are at the party now?
Skills Practice

Problem-Solving Investigation: Act It Out

Solve. Use the *act it out* strategy.

1. **PAPER** A paper is folded in half four times. Once reopened, how many sections are there?

2. **JEWELRY** Brody is making a necklace, bracelet, and anklet out of beads. She has green, blue, purple, and silver beads. How many different pieces of jewelry can she make if she only uses one color of beads for each?

3. **CLOTHES** You can buy school uniforms through an online catalog. Boys can order either navy blue or khaki pants with a red, white, or blue shirt. How many uniform combinations are there online for boys?

4. **TIME** School is out at 3:45 P.M., band practice is 2\(\frac{1}{2}\) hours, dinner takes 45 minutes, and you go to bed at 10:00 P.M. How much free time will you have if you study for 2 hours for a math exam?
Problem-Solving Practice

Problem-Solving Investigation: Act It Out

1. EVENTS Jonah is arranging students around square tables that are lined up in a row, end to end. Three students can fit on the side of one table. How many people can he seat with 3 tables?

2. FOOD About how much more money is spent on strawberry and grape jelly than the other types of jelly?

<table>
<thead>
<tr>
<th>Yearly Jelly Sales (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strawberry and Grape jelly</td>
</tr>
<tr>
<td>All others</td>
</tr>
</tbody>
</table>

3. SHOPPING Jen-Li has $95 to spend on athletic shoes. The shoes she wants to buy cost $59.99. If you buy one pair, you get a second pair for half price. About how much money will she have left over if she purchases two pairs of the shoes?

4. FIELD TRIP Mrs. Samuelson had $350 to spend on a field trip for herself and 18 students. Admission was $12.50 per person and lunch cost about $5.00 per person. How much money was left after the trip?

5. MONEY The table gives admission costs for a home improvement fair. A group of twelve people paid a total of $50 for admission. If 8 of them were children, how many people in the group were adults and how many were senior citizens?

<table>
<thead>
<tr>
<th>Home Improvement Admission Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
</tr>
<tr>
<td>Children</td>
</tr>
<tr>
<td>Senior Citizens</td>
</tr>
</tbody>
</table>

6. GEOMETRY If the pattern shown below is continued, find the number of dots in Figure 5.

[Diagram of figures 1, 2, and 3 showing the pattern of dots increasing.]
Lesson 5 Homework Practice

Algebra: Properties

Determine whether the two expressions are equivalent. If so, tell what property is applied. If not, explain why.

1. $7 \cdot (6 \cdot t)$ and $(7 \cdot 6) \cdot t$
2. $23 + 15$ and $15 + 23$

3. $18 - (7 - 3)$ and $(18 - 7) - 3$
4. $8 \cdot 1$ and $8$

5. $x \cdot 1$ and $1 \cdot x$
6. $10 \div 5$ and $5 \div 10$

Use one or more properties to rewrite each expression as an expression that does not use parentheses.

7. $(b + 3) + 6$
8. $7 + (3 + t)$

9. $9 \cdot (k \cdot 5)$
10. $1 + (h + 2)$

11. GROCERY A grocery store sells an imported specialty cheese for $11 and its own store-brand cheese for $5. Write two equivalent expressions for buying one of each cheese and an unknown amount of other groceries.

12. CHECKING ACCOUNT Mr. Kenrick made three deposits to his account in this order: $460, $185, and $240. Show how to use the Commutative Property to find the sum of the deposits mentally.

13. PETS Luzon has 8 fish, 3 cats, and 2 dogs. Write two equivalent expressions using the Associative Property that can be used to find the total number of pets.
Lesson 5 Skills Practice

Algebra: Properties

Determine whether the two expressions are equivalent. If so, tell what property is applied. If not, explain why.

1. $2 \cdot (3 \cdot 7)$ and $(2 \cdot 3) \cdot 7$
2. $6 + 3$ and $3 + 6$

3. $26 - (9 - 7)$ and $(26 - 9) - 7$
4. $18 \cdot 1$ and $18$

5. $7 \cdot 2$ and $2 \cdot 7$
6. $6 - (4 - 1)$ and $(6 - 4) - 1$

7. $7 + 0$ and $7$
8. $0 + 12$ and $0$

9. $625 + 281$ and $281 + 625$
10. $(12 \cdot 18) \cdot 5$ and $12 \cdot (18 \cdot 5)$

11. $2 + (8 + 2)$ and $(2 + 8) + 2$
12. $40 \div 10$ and $10 \div 40$

Use one or more properties to rewrite each expression as an expression that does not use parentheses.

13. $(p \cdot 1) \cdot 6$
14. $(a + 5) + 23$

15. $7 \cdot (y \cdot 3)$
16. $(b + 4) + 17$

17. $6 + (x + 50)$
18. $(y \cdot 200) \cdot 2$
Lesson 5 Extra Practice

**Algebra: Properties**

Determine whether the two expressions are equivalent. If so, tell what property is applied. If not, explain why.

1. \(7 \cdot (3 \cdot 2)\) and \((7 \cdot 3) \cdot 2\)

2. \(16 \div 8\) and \(8 \div 16\)

3. \(27 \cdot 1\) and 1

4. \(16 + 0\) and 16

5. \(12 - (5 - 2)\) and \((12 - 5) - 2\)

6. 14 and 1 \(\cdot\) 14

7. \(32 + 4\) and \(4 + 32\)

8. \(40 \div (8 \div 2)\) and \((40 \div 8) \div 2\)
Lesson 5 Problem-Solving Practice

Algebra: Properties

1. MUSIC Mr. Escalante and Mrs. Turner plan to take their music classes to a musical revue. Tickets cost $6 each. They need a total of 48 tickets. Use the Commutative Property to write two equivalent expressions that could be used to find the total cost.

2. SAVINGS Mrs. Perez was looking at her bank account statement. She noticed that her beginning balance was $500, and she had added nothing to her account. What was the ending balance on her statement? What property did you apply?

3. ADDITION Mr. Brooks was working on addition using dominoes with a group of 1st graders. When picking the domino with 3 dots on one end and 5 dots on the other, some students read, “3 plus 5 equals 8” while others read it as, “5 plus 3 equals 8.” What property were these children using? Explain.

4. AREA Taylor noticed that for the rectangle below she could multiply 2 times 3 to get its area of 6 square inches. How else could she find the area?

[Diagram of a rectangle with dimensions 3 in. by 2 in.]

5. NUMBER CUBES Students in Mr. Rivas’ class were practicing their multiplication skills by rolling three 6-sided number cubes. Wapi rolled a 2, a 3, and a 5. He multiplied the three numbers as follows using the order of operations: \((2 \times 3) \times 5 = 30\). Write another way Wapi could have performed the multiplication without changing the order of the numbers. State the property you used.

6. FACTS Bik was working on memorizing her multiplication facts. She noticed that anytime she multiplied a number by 1, she got the same number she started with. What property allows this to be true?
The Closure Property

You have learned about several properties and have seen how they can be true for only certain operations. For example, the Commutative and Associative Properties only apply to addition and multiplication. Now, you will learn about a new property, the Closure Property.

The Closure Property involves thinking of operations and sets of numbers. It states that for a set of numbers, and for a given operation, the set of numbers is closed under that operation if the result of performing the operation belongs to that same set of numbers.

Before looking at examples, define two number sets.

Counting Numbers: 1, 2, 3, …
Whole Numbers: 0, 1, 2, 3, …

Notice that neither set includes fractions or decimals. The whole numbers are the counting numbers plus 0.

Example 1
The set of counting numbers is closed under addition because the result of adding any two counting numbers is another counting number.

Example 2
The set of counting numbers is not closed under subtraction because the result of subtracting two counting numbers does not have to be another counting number. For example, 3 − 3 = 0.

Exercises

Tell if the set is closed under the given operation. If not, provide a counter example.

1. whole numbers, addition
2. whole numbers, multiplication
3. counting numbers, division
4. whole numbers, division
5. even numbers, addition
6. odd numbers, addition
7. even numbers, multiplication
8. odd numbers, multiplication
Lesson 6 Homework Practice

The Distributive Property

Find each product mentally. Show the steps you used.
1. $8 \times 34$
2. $5 \times 47$
3. $12 \times 4 \frac{3}{4}$
4. $8 \times 3 \frac{3}{4}$
5. $6 \times 4.4$
6. $7 \times 2.9$

Use the Distributive Property to rewrite each algebraic expression.
7. $6(n + 4)$
8. $15(2 + r)$
9. $8(s + 5)$
10. $3(b + 8)$
11. $5(6 + b)$
12. $9(3 + v)$
13. $7(r - 7)$
14. $12(4 - v)$
15. $11(3 - s)$

16. MOVIES Use the table that shows the prices of tickets and various food items at the movie theater.

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ticket</td>
<td>$8.50</td>
</tr>
<tr>
<td>Popcorn</td>
<td>$5.25</td>
</tr>
<tr>
<td>Soda</td>
<td>$4.00</td>
</tr>
<tr>
<td>Candy</td>
<td>$3.75</td>
</tr>
<tr>
<td>Nachos</td>
<td>$6.50</td>
</tr>
</tbody>
</table>

a. Four friends each bought a ticket and a bag of popcorn. How much total money did they spend?

b. How much money will the movie theater make if a birthday party of 12 kids each buys a box of candy and a soda but does not go see a movie?

c. How much more money will a person spend who buys three orders of nachos than a person who buys three bags of popcorn?
Lesson 6 Skills Practice

The Distributive Property

Find each product mentally. Show the steps you used.

1. $3 \times 78$
2. $7 \times 74$

3. $8 \times 92$
4. $6 \times 57$

5. $15 \times 2\frac{2}{3}$
6. $12 \times 5\frac{1}{6}$

7. $6 \times 5.2$
8. $4 \times 9.4$

Use the Distributive Property to rewrite each algebraic expression.

9. $7(y + 2)$
10. $(8 + r)4$
11. $8(x + 9)$

12. $(b + 5)12$
13. $4(2 + a)$
14. $7(6 + v)$

15. $(b - 5)15$
16. $3(5 - v)$
17. $6(11 - s)$
Lesson 6 Extra Practice

*The Distributive Property*

Find each expression mentally. Show the steps you used.

1. \(3 \times 24\)  
2. \(8 \times 67\)  
3. \(5 \times 39\)

4. \(9 \times 48\)  
5. \(4 \times 52\)  
6. \(6 \times 75\)

7. \(2 \times 3.7\)  
8. \(7 \times 4.2\)  
9. \(3 \times 5.4\)

Use the Distributive Property to rewrite each algebraic expression.

10. \(4(x + 3)\)  
11. \(7(x + 4)\)  
12. \(2(x + 8)\)

13. \(9(x + 6)\)  
14. \(3(x + 11)\)  
15. \(5(x + 7)\)

16. \(6(x + 4)\)  
17. \(8(x + 9)\)  
18. \(4(x + 5)\)
Lesson 6 Problem-Solving Practice

The Distributive Property

For Exercises 1 and 2, use the table that shows the number of seats available on various types of aircrafts.

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>737</td>
<td>150</td>
</tr>
<tr>
<td>757</td>
<td>183</td>
</tr>
<tr>
<td>767</td>
<td>250</td>
</tr>
<tr>
<td>MD-88</td>
<td>142</td>
</tr>
<tr>
<td>777</td>
<td>268</td>
</tr>
</tbody>
</table>

1. **SEATS** How many total seats will the airline gain by purchasing three more of both the 737 aircrafts and MD-88 aircrafts?

2. **PASSENGERS** How many more passengers can sit on four 777 aircrafts than on four 767 aircrafts?

3. **SEATING** The Valley High School Auditorium is able to seat 8 elementary school groups of 65 students each. Use the Distributive Property to determine how many students they can seat.

4. **SHOPPING** Five friends each buy a shirt that costs $x dollars and a pair of shoes that cost $24.00. Write an expression to show how much total money they spent. Then rewrite the expression using the Distributive Property.

5. **CARS** A rental company buys 7 compact cars for $8,500 each and 7 midsize cars for $12,500 each. How much total money will they spend?

6. **BAKING** A baking company charges $1.75 per slice of cake for baking and $0.35 per slice for decorating. How much would a decorated cake cost containing 150 slices?
A Number Puzzle

Rewrite the following algebraic expressions using the Distributive Property. Match each answer with its corresponding letter to reveal the hidden message.

1. $6(x + 2)$  
   
2. $4(x + 3)$  
   
3. $2(x + 6)$  
   
4. $9(1 + x)$  
   
5. $3(x + 3)$  
   
6. $12(x + 1)$  
   
7. $2(x + 2)$  
   
8. $4(3 + x)$  
   
9. $6(x + 6)$  
   
10. $2(x + 12)$  
    
11. $12(x + 2)$  
    

<table>
<thead>
<tr>
<th>4x + 12</th>
<th>9 + 9x</th>
<th>2x + 4</th>
<th>6x + 36</th>
</tr>
</thead>
<tbody>
<tr>
<td>12x + 24</td>
<td>12 + 4x</td>
<td>6x + 12</td>
<td></td>
</tr>
<tr>
<td>12x + 12</td>
<td>2x + 4</td>
<td>3x + 9</td>
<td></td>
</tr>
<tr>
<td>9 + 9x</td>
<td>12x + 12</td>
<td>2x + 12</td>
<td>3x + 9</td>
</tr>
<tr>
<td>12 + 4x</td>
<td>2x + 12</td>
<td>12 + 4x</td>
<td></td>
</tr>
<tr>
<td>2x + 24</td>
<td>12 + 4x</td>
<td>6x + 12</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 7 Homework Practice

Equivalent Expressions

Simplify each expression.

1. \((7 + x) + 7x\)
2. \(5 \cdot (4 \cdot x)\)
3. \(15y + (x + 9y)\)

4. \((6x + 21) + 14\)
5. \(3x + 2 + 11x\)
6. \((x + 13y) + 8y\)

7. \((12y + 2x) + 4y\)
8. \(8 \cdot (x \cdot 4)\)
9. \(3(5x)\)

10. \(3x + (7x + 10)\)
11. \(5x + (2 + x)\)
12. \(4 \cdot x \cdot 10\)

13. \((x \cdot 12) \cdot 3\)
14. \(14x + 9y + 6x\)
15. \(5x + (24 + 14x)\)

ALGEBRA For Exercises 16 through 21, translate each verbal expression into an algebraic expression. Then, simplify the expression.

16. The sum of three and a number is added to twenty-four.

17. The product of six and a number is multiplied by nine.

18. The sum of 10 times a number and fifteen is added to eleven times the same number.

19. Two sets of the sum of a number and eight are added to five times the same number.

20. Three sets of a sum of a number and four are added to the sum of seven times the same number and thirteen.

21. Five friends went to a baseball game. Three of the friends each bought a ticket for \(x\) dollars and a soda for $6.00. The other two friends each bought only tickets. Write and simplify an expression that represents the amount of money spent.
Lesson 7 Skills Practice

Equivalent Expressions

Simplify each expression.

1. \(x + 4 + 3x\)  
2. \(3 + (x + 6)\)  
3. \(15 + (6 + x)\)

4. \((6 + x) + 9\)  
5. \(x + 2 + 8x\)  
6. \((4x + 3y) + 23y\)

7. \((25y + 5x) + 4y\)  
8. \(15 \cdot (5 \cdot x)\)  
9. \(7(4x)\)

10. \(8x + (16 + 4x)\)  
11. \(x + 2 + x\)  
12. \(5 \cdot x \cdot 10\)

13. \((17 \cdot x) \cdot 3\)  
14. \(8x + 17y + 9x\)  
15. \(3x + (24x + 8)\)

16. \(4(15x)\)  
17. \(2x + 8 + x\)  
18. \((5x + 9y) + 32x\)

A car company charges \(x\) dollars to rent a car plus any extra options shown in the table. Use the information to answer Exercises 19 and 20.

<table>
<thead>
<tr>
<th>Extra Options</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Seat</td>
<td>$50</td>
</tr>
<tr>
<td>Insurance</td>
<td>$75</td>
</tr>
<tr>
<td>Car Wash</td>
<td>$15</td>
</tr>
</tbody>
</table>

19. Three people each rented a car with insurance and one more person rented a car with a car wash. Write an expression that represents the total cost of the car rentals and extra options.

Lesson 7 Extra Practice

*Equivalent Expressions*

Simplify each expression.

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

4. \(9x + 3x\)  
5. \(7x + 4x\)  
6. \(10x + x\)

7. \(3x + 2 + 4x\)  
8. \(15x + 3 + x\)  
9. \(2x + 5 + 6x\)

10. \(7x + 2x + 4\)  
11. \(18x + 3x + 9\)  
12. \(6x + x + 8\)

Factor each expression.

13. \(21x + 15y\)  
14. \(2x + 14y\)  
15. \(15x + 10y\)

16. \(12x + 18y\)  
17. \(10x + 30y\)  
18. \(6x + 14y\)

19. \(8x + 16y\)  
20. \(45x + 27y\)  
21. \(54x + 48y\)
Lesson 7 Problem-Solving Practice

Equivalent Expressions

1. **AMUSEMENT PARKS** Four friends went to a local amusement park. Three of the friends bought ride tickets for \(x\) dollars, plus a game pass for $10. The other friend bought just a ride ticket. Write and simplify an expression showing the amount of total money spent.

2. **ALGEBRA** Translate and simplify the expression: the sum of fifteen and a number plus twelve.

3. **AGE** Julianna is \(x\) years old. Her sister is 2 years older than her. Her mother is 3 times as old as her sister. Her Uncle Rich is 5 years older than her mother. Write and simplify an expression representing Rich’s age.

4. **REASONING** In the expression \(30 + 40 + 70\), Jillian added 30 and 40 and then 70, while Samuel added 30 and 70 and then 40. Who is correct? Explain your reasoning.

**ICE CREAM** For Exercises 5 and 6, use the following information provided in the table.

<table>
<thead>
<tr>
<th>Toppings</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Cream (Scoop)</td>
<td>(x) dollars</td>
</tr>
<tr>
<td>Sprinkles</td>
<td>$0.25</td>
</tr>
<tr>
<td>Hot Fudge</td>
<td>$0.75</td>
</tr>
<tr>
<td>Whipped Cream</td>
<td>$0.50</td>
</tr>
<tr>
<td>Nuts</td>
<td>$0.35</td>
</tr>
</tbody>
</table>

5. Ten kids each order a scoop of ice cream. Five of the kids add sprinkles, 3 add nuts, and 2 add nothing extra. Write and simplify an expression that represents the total cost.

6. Write and simplify an expression that represents the total cost of ordering nuts on a scoop of ice cream and then adding hot fudge.
Extended Simplifying Algebraic Expressions

Like Terms are groups of terms which contain the same variables, such as $3x$ and $x$ or $2y$ and $8y$. In extended algebraic expressions, there are often multiple sets of like terms. When solving these problems, first isolate the like terms and then combine them together.

Simplify the algebraic expression. Justify your steps.

$$4x + 5y + 3 + 8y + 7x + 2x + 15 + y + 8$$

$$= 4x + 5y + 3 + 8y + 9x + 15 + y + 8$$ Combine like terms.
$$= 4x + 5y + 8y + 3 + 9x + 15 + y + 8$$ Commutative Property
$$= 4x + 13y + 3 + 9x + 15 + y + 8$$ Combine like terms.
$$= 4x + 13y + 18 + 9x + y + 8$$ Commutative Property
$$= 4x + 13y + 9x + 18 + y + 8$$ Add.
$$= 4x + 13y + 9x + y + 26$$ Commutative Property
$$= 4x + 9x + 13y + y + 26$$ Add.
$$= 13x + 13y + y + 26$$ Combine like terms.
$$= 13x + 14y + 26$$ Combine like terms.

Simplify the following expressions. Justify your steps.

1. $2(x + 4) + 3(y + x) + 17 + x + 4y$

$$= 2x + 8 + 3(y + x) + 17 + x + 4y$$ Dist.
$$= 2x + 8 + 3y + 3x + 17 + x + 4y$$ Dist.
$$= 2x + 8 + 3y + 3x + x + 17 + 4y$$ Comm.
$$= 2x + 8 + 3y + 4x + 17 + 4y$$ Like terms
$$= 2x + 8 + 4x + 3y + 17 + 4y$$ Comm.
$$= 6x + 8 + 3y + 17 + 4y$$ Comm.
$$= 6x + 8 + 3y + 4y + 17$$ Comm.
$$= 6x + 8 + 7y + 17$$ Like terms
$$= 6x + 7y + 17$$ Comm.
$$= 6x + 7y + 25$$ Add.

2. $(3 + 2x) + x + y + (15 + 6y) + 24 + 8z$

$$= 3 + (2x + x) + y + (15 + 6y) + 24 + 8z$$ Assoc.
$$= 3 + 3x + y + (15 + 6y) + 24 + 8z$$ Like terms
$$= 3 + 3x + y + (6y + 15) + 24 + 8z$$ Comm.
$$= 3 + 3x + y + 6y + (15 + 24) + 8z$$ Assoc.
$$= 3 + 3x + y + 6y + 39 + 8z$$ Add.
$$= 3 + 3x + 7y + 39 + 8z$$ Like terms
$$= 3 + 3x + 39 + 7y + 8z$$ Comm.
$$= 3 + 39 + 3x + 7y + 8z$$ Comm.
$$= 42 + 3x + 7y + 8z$$ Add.