Your study of math requires analysis of data, much of which will be in decimal form. In this unit, you will learn how to evaluate algebraic expressions involving decimals, as well as analyze and graph data.
Are you ready to join a team of animal experts? As part of your application to be a Zoo’s new coordinator, you must complete several challenging tasks. You’ll make decisions about what animals to purchase for the zoo based on financial information provided to you. You’ll gather specific data about the animals you choose, including their weight and expected lifespan. Finally, you’ll present your findings to the hiring committee. So pack up your gear and don’t forget your algebra tool kit. This adventure is going to be wild!

Log on to msmath2.net/webquest to begin your WebQuest.
What does exercising have to do with math?

A 13-year-old has a minimum training heart rate of about 124 beats per minute. You can use the expression $0.6(220 - a)$, where $a$ stands for a person’s age to find a person’s minimum training heart rate. Other real-life situations can also be modeled using expressions and variables.

You will solve problems about your health in Lesson 1-4.
Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 1. Refer to the page number in parentheses for review.

Vocabulary Review
State whether each sentence is true or false. If false, replace the underlined word to make a true sentence.

1. A decimal point separates the ones place and the tenths place. (Page 555)
2. When multiplying or subtracting decimals, you must first line up the decimal points. (Page 555)

Prerequisite Skills
Add. (Page 559)
3. 89.3 + 16.5
4. 7.9 + 32.45
5. 54.25 + 6.39
6. 10.8 + 2.6

Subtract. (Page 559)
7. 24.6 − 13.3
8. 9.1 − 6.6
9. 30.55 − 2.86
10. 17.4 − 11.2

Multiply. (Page 560)
11. 4 × 7.7
12. 9.8 × 3
13. 2.7 × 6.3
14. 8.5 × 1.2

Divide. (Page 562)
15. 32.6 ÷ 4
16. 10.6 ÷ 2
17. 5.5 ÷ 5
18. 17.84 ÷ 4

Multiply or divide. (Page 562)
19. 2.45 × 1,000
20. 87.3 ÷ 100
21. 0.61 × 100
22. 10 ÷ 1,000
In mathematics, there is a *four-step plan* you can use to help you solve math problems.

1. **Explore**
   - Determine what information is given and what you need to find.
   - Do you have all the information to solve the problem?
   - Is there any information given that is not needed?

2. **Plan**
   - Select a strategy for solving the problem. There may be several that you can use.
   - It is usually helpful to estimate the answer.

3. **Solve**
   - Carry out your plan.
   - If your plan doesn’t work, keep trying until you find one that does work.
   - Make sure your solution contains appropriate units or labels.

4. **Examine**
   - Does your answer make sense given the facts in the problem?
   - Is your answer reasonable compared to your estimate?
   - If your answer is not correct, make a new plan and start again.
Use the Four-Step Plan

**TELEVISION** Color TV sets were first mass-produced in 1954. In that year, 5,000 color TVs were produced. How many years passed before at least 100 times as many were produced?

<table>
<thead>
<tr>
<th>Year</th>
<th>Color TVs Produced</th>
<th>Year</th>
<th>Color TVs Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1954</td>
<td>5,000</td>
<td>1960</td>
<td>120,000</td>
</tr>
<tr>
<td>1955</td>
<td>20,000</td>
<td>1961</td>
<td>140,000</td>
</tr>
<tr>
<td>1956</td>
<td>90,000</td>
<td>1962</td>
<td>450,000</td>
</tr>
<tr>
<td>1957</td>
<td>85,000</td>
<td>1963</td>
<td>750,000</td>
</tr>
<tr>
<td>1958</td>
<td>80,000</td>
<td>1964</td>
<td>1,500,000</td>
</tr>
<tr>
<td>1959</td>
<td>90,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Sams Photofact Book on Color TV*

**Explore** What are you trying to find?
The number of years since 1954 that 100 times as many TVs were produced.

**What information do you need to solve the problem?**
From the table, you know the number of TVs produced each year from 1954 to 1964.

**Plan** You can estimate the number of years that passed before at least 100 times 5,000 TVs, or 500,000 TVs were produced. This happened between 1962 and 1963. So, approximately 10 years had passed.

**Solve**

\[100 \times 5,000 = 500,000\] TVs

In 1963, 750,000 TVs were produced, which is more than 500,000 TVs. Since \(1963 - 1954 = 9\), nine years passed before production was at least 100 times greater than the number of sets produced in 1954.

**Examine** Is your answer reasonable?
Look at the data in the table and count the number of years from 1954 to 1963. Also, compare your answer to the estimate.

**Your Turn** Solve using the four-step plan.
a. How many times more TVs were produced in 1960 than in 1954?
b. Between which two years did TV production increase the most?

Problems can be solved using different operations or strategies.

**Key Concept: Problem-Solving Strategies**

- guess and check
- look for a pattern
- make an organized list
- draw a diagram
- act it out
- solve a simpler problem
- use a graph
- work backward
- eliminate possibilities
- estimate reasonable answers
- use logical reasoning
- make a model
Use a Strategy in the Four-Step Plan

In a basketball tournament, 128 teams play in the first round. Then there are 64 teams left to play in the second round, 32 teams left to play in the third round, and so on. How many rounds does it take to determine a winner?

**Explore**
You know the number of teams at the start of the tournament and how many teams play in each of the first three rounds.

**Plan**
You can look for a pattern by organizing the information in a table. Then continue the pattern until one team is left.

**Solve**

<table>
<thead>
<tr>
<th>Round</th>
<th>Number of Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>128</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

So, a winner is determined in 7 rounds.

**Examine**
You could complete the diagram below to show that the answer is reasonable.

- Round 1: 128 teams: 64 teams win, 64 teams lose
- Round 2: 64 teams: 32 teams win, 32 teams lose
- Round 3: 32 teams: 16 teams win, 16 teams lose

**Your Turn**

C. How many rounds would it take to determine a winner if 512 teams participated in the tournament?

1. **Explain** why it is important to plan before solving a problem.
2. **Writing Math** Describe what to do if your solution to a problem seems unrealistic.
3. **OPEN ENDED** Write a real-life problem that can be solved by adding 79 and 42.

**GUIDED PRACTICE**

Use the four-step plan to solve each problem.

4. **MONEY** To attend the class picnic, each student will have to pay $5.00 for transportation and $6.50 for food. If there are 300 students in the class, how much money will be collected for the picnic?

5. **PATTERNS** If Isaac receives an E-mail every 20 minutes during the workday, how many E-mails would he expect to receive between 8:00 A.M. and noon?
**Practice and Applications**

Use the four-step plan to solve each problem.

6. **VIDEO RENTALS** A video store took in $5,400 in video rentals during July. January sales are expected to be double that amount. If videos rent for $4, how many video rentals are expected in January?

7. **RACING** The Indianapolis Motor Speedway has 3,200,000 bricks that lie beneath the 2.5 miles of track. Find how many bricks lie under one mile of track at the race track.

8. **COOKING** Mr. Sanchez is serving Cajun fried turkey at 3:00 P.M. The 15-pound turkey has to remain in the fryer 3 minutes for every pound and must cool for at least 45 minutes before it is carved. What is the latest time he can start frying?

9. **GEOMETRY** Draw the next two figures in the pattern.
   
   ![Pattern](image)

10. **MULTI STEP** Kishi wants to buy a DVD player that costs $250 with tax. So far, she has saved $145. If she saves $5 every week, in how many weeks will she be able to purchase the DVD player?

11. **COLLECTIONS** In 2001, Dustin started collecting 6 die-cast cars every year. In 2003, his brother Logan started collecting 9 cars per year. In what year did Dustin and Logan have the same number of cars?

12. **CRITICAL THINKING** Use the digits 1, 2, 3, 4, and 5 to form a two-digit and a three-digit number so that their product is the least product possible. Use each digit only once.

13. **SHORT RESPONSE** Jeannie has $86 to spend on birthday gifts for her mother. Which three items from the table could Jeannie purchase for her mother, not including tax?

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>sweater</td>
<td>$29.50</td>
</tr>
<tr>
<td>gloves</td>
<td>$22.75</td>
</tr>
<tr>
<td>purse</td>
<td>$32.00</td>
</tr>
<tr>
<td>chocolates</td>
<td>$15.00</td>
</tr>
<tr>
<td>movie passes</td>
<td>$27.75</td>
</tr>
</tbody>
</table>

14. **MULTIPLE CHOICE** In a field near Duns, Scotland, a reproduction of the painting *Sunflowers* was created with 250,000 plants and flowers. The “painting” covered a 46,000-square foot area. What is a reasonable number of plants and flowers per square foot?

   - A 5
   - B 50
   - C 100
   - D 500

**BASIC SKILL** Multiply.

15. \(10 \times 10\)  
16. \(3 \times 3 \times 3\)  
17. \(5 \times 5 \times 5 \times 5\)  
18. \(2 \times 2 \times 2 \times 2 \times 2\)


**What You’ll LEARN**

Use powers and exponents.

**NEW Vocabulary**

- factors
- exponent
- base
- powers
- squared
- cubed
- evaluate
- standard form
- exponential form

---

**TECHNOLOGY** Computer engineer Gordon E. Moore made this observation in 1964. Moore’s Law says the amount of available storage space on a computer chip doubles every year.

1. How is doubling shown in the table?
2. If the pattern continued, how much storage space would be available by year 6?
3. What is the relationship between the number of 2s and the year?

---

Two or more numbers that are multiplied together to form a product are called **factors**. The amount of storage space on a computer chip in year 4 can be written using only factors of 2. When the same factor is used, you may use an exponent to simplify the notation.

- The centered dots indicate multiplication.
- The exponent tells how many times the base is used as a factor.
- The base is the common factor.

Numbers expressed using exponents are called **powers**. You can say that $2^4$ is a power of 2. This and the powers $5^2$ and $4^3$ are read as follows.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5^2$</td>
<td>five to the second power or five squared</td>
</tr>
<tr>
<td>$4^3$</td>
<td>four to the third power or four cubed</td>
</tr>
<tr>
<td>$2^4$</td>
<td>two to the fourth power</td>
</tr>
</tbody>
</table>

---

**EXAMPLES**

**Write Powers as Products**

Write each power as a product of the same factor.

- **$7^5$**
  - The base is 7. The exponent 5 means that 7 is used as a factor five times.
  - $7^5 = 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$

- **$3^2$**
  - The base is 3. The exponent 2 means the 3 is used as a factor twice.
  - $3^2 = 3 \cdot 3$
You can evaluate, or find the value of, powers by multiplying the factors. Numbers written without exponents are in standard form.

Write Powers in Standard Form

Evaluate each expression.

\[ 2^5 \]

\[ 2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32 \]

\[ 4^3 \]

\[ 4^3 = 4 \cdot 4 \cdot 4 = 64 \]

Your Turn Evaluate each expression.

a. \[ 10^2 \]

b. \[ 7^3 \]

c. \[ 5^4 \]

Numbers written with exponents are in exponential form.

Write Numbers in Exponential Form

Write \(3 \cdot 3 \cdot 3 \cdot 3\) in exponential form.

3 is the base. It is used as a factor 4 times. So, the exponent is 4.

\[ 3 \cdot 3 \cdot 3 \cdot 3 = 3^4 \]

Your Turn Write each product in exponential form.

d. \[ 5 \cdot 5 \cdot 5 \]

e. \[ 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 \]

Skill and Concept Check

1. Explain what five to the fourth power means.

2. Write \(7^5\) in words.

3. OPEN ENDED Write one number in exponential form and another number in standard form.

4. Which One Doesn’t Belong? Identify the number that cannot be written as a power with an exponent greater than 1. Explain your reasoning.

1. \[ 4 \]

2. \[ 9 \]

3. \[ 16 \]

4. \[ 50 \]

Guided Practice

Write each power as a product of the same factor.

5. \[ 6^2 \]

6. \[ 4^4 \]

7. \[ 8^5 \]

Evaluate each expression.

8. \[ 3^4 \]

9. \[ 5^5 \]

10. \[ 10^3 \]

Write each product in exponential form.

11. \[ 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \]

12. \[ 1 \cdot 1 \cdot 1 \cdot 1 \]

13. Evaluate eleven to the third power.
Write each power as a product of the same factor.

14. \(1^5\)  
15. \(4^2\)  
16. \(3^8\)

17. \(9^3\)  
18. \(10^4\)  
19. \(11^3\)

Evaluate each expression.

20. \(2^3\)  
21. \(2^6\)  
22. \(4^3\)  
23. \(5^4\)

24. \(1^{10}\)  
25. \(10^1\)  
26. \(3^8\)  
27. \(4^6\)

28. \(10^5\)  
29. \(12^4\)  
30. \(20^4\)  
31. \(50^3\)

Write each product in exponential form.

32. \(3 \cdot 3\)  
33. \(7 \cdot 7 \cdot 7 \cdot 7\)  
34. \(1 \cdot 1 \cdot 1\)

35. \(6 \cdot 6 \cdot 6 \cdot 6\)  
36. \(4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4\)  
37. \(13 \cdot 13 \cdot 13 \cdot 13 \cdot 13\)

38. Find the value of \(6\) cubed.

39. Express 256 in exponential form as a power of 2.

GEOMETRY For Exercises 40 and 41, use the figures below.

40. Find the number of unit cubes that make up each large cube. Write your answers using exponents.

41. Why do you think the expression \(2^3\) is sometimes read as \(2\) cubed?

Use a calculator to determine whether each sentence is true or false.

42. \(3^7 > 7^3\)  
43. \(14^4 = 19^2\)  
44. \(927 > 9^3\)

45. \(3^2 = 2^3\)  
46. \(6^3 < 4^4\)  
47. \(3^4 < 9^2\)

Order the following numbers from least to greatest.

48. \(6^5, 1^{14}, 4^{10}, 17^3\)
49. \(2^8, 15^2, 6^3, 3^5\)
50. \(5^3, 4^6, 2^{11}, 7^2\)

51. \(6^4, 3^6, 5^5, 8^3\)
52. \(3^7, 10^3, 8^2, 2^{10}\)
53. \(6^5, 9^4, 11^3, 5^5\)

54. POPULATION There are approximately \(7^{10}\) people living in the United States. About how many people is this?

55. Explain why a quadrillion, \(10^{15}\), is usually written in exponential form instead of standard form.

56. Tell whether the following statement is true or false. Explain your reasoning. The number 64 can be written in exponential form in only one way.

57. Use exponents to write \(5 \cdot 5 \cdot 5 \cdot 5 \cdot 4 \cdot 4 \cdot 4\) in the shortest form possible.
58. **MULTI STEP** Use a calculator to express 1,679,616 in exponential form as a power of 6.

59. **POPULATION** The population of Fort Worth, Texas, is approximately 534,000. Find a number less than 534,000 and a number greater than 534,000 that can be expressed in exponential form.

60. **RESEARCH** Our numbering system is based on the powers of 10. The ancient Mayan system is based on another power. Use the Internet or another source to write a paragraph about the Mayan numbering system.

61. **PHYSICAL SCIENCE** The speed of sound varies as it travels through different substances. At ordinary temperatures, sound travels through water at a rate of 5,000 feet per second. Write 5,000 using exponents and the factors 5 and 10.

62. **CRITICAL THINKING** Based on the number pattern shown at the right, write a convincing argument that any number, except 0, raised to the 0 power equals 1.

63. **MULTIPLE CHOICE** Which is two to the sixth power written in standard form?
   - A) 26
   - B) 6 \cdot 6
   - C) 64
   - D) 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2

64. **GRID IN** How many zeros does the value of 10^8 have?

65. **RACING** The graph shows which numbered-cars have the most wins at the Indianapolis 500. How many more wins did the number 3 car have than the number 14 car? (Lesson 1-1)

66. **PRODUCTION** A machine on a production line fills 8 soft drink cans per minute. How many cans does it fill in 8 hours? (Lesson 1-1)

67. **True or False?** In the four-step plan, the **Solve** step comes last. (Lesson 1-1)

**Spiral Review with Standardized Test Practice**

63. **MULTIPLE CHOICE** Which is **two to the sixth power** written in standard form?
   - A) 26
   - B) 6 \cdot 6
   - C) 64
   - D) 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2

64. **GRID IN** How many zeros does the value of 10^8 have?

65. **RACING** The graph shows which numbered-cars have the most wins at the Indianapolis 500. How many more wins did the number 3 car have than the number 14 car? (Lesson 1-1)

66. **PRODUCTION** A machine on a production line fills 8 soft drink cans per minute. How many cans does it fill in 8 hours? (Lesson 1-1)

67. **True or False?** In the four-step plan, the **Solve** step comes last. (Lesson 1-1)

**Getting Ready for the Next Lesson**

**PREREQUISITE SKILL** Add, subtract, multiply, or divide. (Pages 559, 560, 562)

68. 13.4 + 8.7
69. 13.6 – 10.2
70. 1.5 \times 6.8
71. 8.6 – 5.53
72. 36 \div 3
73. 1.7 + 32.28
74. 3.2 \times 6
75. 24.5 \div 7
**Order of Operations**

**What You’ll LEARN**
Evaluate expressions using the order of operations.

**NEW Vocabulary**
- numerical expression
- order of operations

---

**am I ever going to use this?**

**GAMES** Kaitlyn and Percy are each writing as many different expressions as possible using the numbers rolled on a number cube. In the first round, 3, 5, 4, and 6 were rolled in order.

- Kaitlyn: $3 \cdot 5 - (4 + 6) = 3 \cdot 5 - 10 = 15 - 10 = 5$
- Percy: $3 \cdot (5 - 4) + 6 = 3 \cdot 1 + 6 = 3 + 6 = 9$

1. List the similarities and differences between the two expressions.
2. What was Kaitlyn’s first step in simplifying her expression? Percy’s first step?
3. Make a conjecture about what should be the first step in simplifying $(3 \cdot 5) - 4 + 6$.

The expressions $3 \cdot 5 - (4 + 6)$ and $3 \cdot (5 - 4) + 6$ are **numerical expressions**. Mathematicians have agreed upon steps called the **order of operations** to find the values of such expressions. These rules ensure that numerical expressions have only one value.

**Key Concept: Order of Operations**

1. Do all operations within grouping symbols first.
2. Evaluate all powers before other operations.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

You can use the order of operations to evaluate numerical expressions.

**Examples**

**Evaluate Expressions**

1. Evaluate $5 + (12 - 3)$.
   
   $5 + (12 - 3) = 5 + 9 \quad \text{Subtract first since } 12 - 3 \text{ is in parentheses.}$
   
   $= 14 \quad \text{Add } 5 \text{ and } 9.$

2. Evaluate $8 - 3 \cdot 2 + 7$.
   
   $8 - 3 \cdot 2 + 7 = 8 - 6 + 7 \quad \text{Multiply } 3 \text{ and } 2.$
   
   $= 2 + 7 \quad \text{Subtract } 6 \text{ from } 8.$
   
   $= 9 \quad \text{Add } 2 \text{ and } 7.$

**Your Turn**

Evaluate each expression.

a. $39 \div (9 + 4)$

b. $10 + 8 \div 2 - 6$
In addition to using the symbols × and ÷, multiplication can be indicated by using parentheses.  

2(3 + 5) means \(2 \times (3 + 5)\) or \(2 \cdot (3 + 5)\).

\((4 - 2)3\) means \((4 - 2) \times 3\) or \((4 - 2) \cdot 3\).

**Evaluate Expressions with Powers**

1. Evaluate \(15 \times 10^3\).
   
   \[15 \times 10^3 = 15 \times 1,000\]  
   
   \[= 15,000\]  
   
   Find the value of \(10^3\).  
   
   Multiply.

2. Evaluate \(36 ÷ (1 + 2)^2\).
   
   \[36 ÷ (1 + 2)^2 = 36 ÷ 3^2\]  
   
   Add 1 and 2 inside the parentheses.  
   
   \[= 36 ÷ 9\]  
   
   Find the value of \(3^2\).  
   
   \[= 4\]  
   
   Divide.

**Your Turn**

Evaluate each expression.

- c. \(3 \times 10^4\)
- d. \((5 - 1)^3 ÷ 4\)

**Evaluate an Expression**

Evaluate \(14 + 3(7 - 2) - 2 \cdot 5\).

\[14 + 3(7 - 2) - 2 \cdot 5\]  

\[= 14 + 3(5) - 2 \cdot 5\]  

Subtract 2 from 7.

\[= 14 + 15 - 2 \cdot 5\]  

Multiply from left to right, \(3 \cdot 5 = 15\).

\[= 14 + 15 - 10\]  

Multiply from left to right, \(2 \cdot 5 = 10\).

\[= 29 - 10\]  

Add from left to right, \(14 + 15 = 29\).

\[= 19\]  

Subtract 10 from 29.

**Use an Expression to Solve a Problem**

**VIDEO GAMES** Evita is buying a video game station, three extra controllers, and four new video games. What is the total cost?

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>game station</td>
<td>1</td>
<td>$180.00</td>
</tr>
<tr>
<td>controller</td>
<td>3</td>
<td>$24.95</td>
</tr>
<tr>
<td>game</td>
<td>4</td>
<td>$35.99</td>
</tr>
</tbody>
</table>

\[
\text{cost of game station} + \text{number of controllers} \times \text{cost of controller} + \text{number of games} \times \text{cost of game}
\]

\[
= 180 + 3 \times 24.95 + 4 \times 35.99
\]

\[
= 180 + 74.85 + 143.96
\]

Multiply from left to right.

\[
= 398.81
\]

Add.

So, the total cost is $398.81.

**Check** Check the reasonableness of the answer by estimating. The cost is about \(180 + (25 \times 3) + (40 \times 4)\) = \(180 + 75 + 160\), or $415. So, the solution of $398.81 is reasonable.
1. Identify the operation that should be done first in each expression.
   a. \( 9 \div 3 + (14 - 7) \)  
   b. \( 3 + 24 \div 3 \cdot 4 \)

2. OPEN ENDED Write an expression containing five numbers that is evaluated by first multiplying.

3. FIND THE ERROR Yutaka and Cynthia are evaluating \( 16 - 24 \div 6 \cdot 2 \). Who is correct? Explain your reasoning.

   \[
   \begin{align*}
   \text{Yutaka} & \quad 16 - 24 \div 6 \cdot 2 \\
   & = 16 - 4 \cdot 2 \\
   & = 16 - 8 \\
   & = 8 \\
   \text{Cynthia} & \quad 16 - 24 \div 6 \cdot 2 \\
   & = 16 - 4 \cdot 2 \\
   & = 16 - 8 \\
   & = 8 
   \end{align*}
   \]

   Yutaka is correct because she followed the order of operations correctly, performing the division before the multiplication, whereas Cynthia did the opposite.

Evaluate each expression.

4. \( 11 - (3 \cdot 2) \)  
5. \( 25 \div (9 - 4) \)  
6. \( 8 - 4 + 3.7 \)

7. \( 2 + 5 \cdot 5 \)  
8. \( 14 \div 2 \cdot 6 \)  
9. \( 8 \cdot 5 - 4 \cdot 3 \)

10. \( 4 \times 10^2 \)  
11. \( 3.5 \times 5 + 6^2 \)  
12. \( 7 + 4(5.6 - 2) - 9 \)

13. Evaluate \( (16 \div 4)^3 - 6 \).  
14. Find the value of \( (6 + 8) \div (10 - 8) \).

Evaluate each expression.

15. \( (1 + 8) \times 3 \)  
16. \( 10 - (3 + 4) \)  
17. \( (25 \div 5) + 8 \)

18. \( (11 - 2) \div 9 \)  
19. \( 3 \cdot 2 + 7 \)  
20. \( 15 \div 3 + 4 \)

21. \( 12 + 6.6 \div 3 \)  
22. \( 18 - 3 \cdot 6 \)  
23. \( 8 - 7.2 + 5 \)

24. \( 28 \div 7(5) \)  
25. \( (17 + 3) \div (4 + 1) \)  
26. \( (6 + 5) \cdot (8 - 6) \)

27. \( 21 \div 3 \times 2 - 4 \)  
28. \( 35 \div 5 + 56 \div 7 \)  
29. \( 2 \times 9 - 4^2 \)

30. \( 24 + 3 + 5^3 \)  
31. \( 7 + (8 - 7 + 2)^4 \)  
32. \( (2 + 10)^2 \div 4 \)

33. \( 6 \times 10^2 \)  
34. \( 18 \times 10^3 \)  
35. \( 1.95 \times 10^2 \)

36. \( 3.7 \times 10^4 \)  
37. \( 6 + 2(9.4 - 1) \)  
38. \( 3(4.5 + 7.2) - 5 \cdot 4 \)

39. \( 72 \div 3 - 5(8.8 - 6) + 9 \)  
40. \( 9 \div 3 \cdot 14(10 - 8) - 60 \)

41. GEOMETRY The distance around a geometric figure is called its perimeter. Write a numerical expression to find the perimeter of the figure at the right. Then evaluate the expression.

42. MARATHONS On Mondays, Wednesdays, and Thursdays, Jacob trains for a marathon for 3.5 hours. On Tuesdays and Fridays, he trains for 2 hours, and on Saturdays, he trains for 4.5 hours. How many hours does Jacob train per week?
Find the value of each expression.
43. $4.5 \times 10^2$  
44. $3.08 \times 10^4$  
45. $2.965 \times 10^5$
46. $3 \cdot (45 - 3.8) + 2.7$  
47. $7.1 \times 9 - (4 + 3) + 1$  
48. $(6 + 1)^2 - 2.5(3)$

49. Insert parentheses to make $72 \div 9 + 27 - 2 = 0$ true.

50. **MONEY MATTERS** Luke is ordering nine reams of paper, four boxes of pens, and two rolls of tape. Use the table to find the cost of his order.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>ream of paper</td>
<td>$3.95</td>
</tr>
<tr>
<td>box of pens</td>
<td>$7.49</td>
</tr>
<tr>
<td>roll of tape</td>
<td>$1.29</td>
</tr>
</tbody>
</table>

**CRITICAL THINKING** Some calculators are programmed to follow the order of operations.

51. Ruby evaluates $12 \div 2 + 2 \cdot 5$ and gets 15. When she checks using her calculator, she gets 16. Which is correct? Explain.

52. Explain how you could tell whether your calculator follows the order of operations.

---

**Spiral Review with Standardized Test Practice**

53. **MULTIPLE CHOICE** Which is the first step in evaluating $10 - 3 \cdot 2 + 4(15 - 5)$?
   A) $10 - 3$  
   B) $3 \cdot 2$  
   C) $2 + 4$  
   D) $15 - 5$

54. **MULTIPLE CHOICE** Anthony has 2 boxes of cookies containing 24 cookies each and 3 packages of brownies containing 15 brownies each. Which expression *cannot* be used to find the total number of items he has?
   F) $3 \times 15 + 2 \times 24$  
   G) $5 \times (24 + 15)$  
   H) $2(24) + 3(15)$  
   I) $15 + 15 + 15 + 24 + 24$

55. **TESTING** Use the graphic to estimate how much longer educators spend preparing students in grades 6–8 for tests than students in grades 9–12. (Lesson 1-1)

**Evaluate each expression.** (Lesson 1-2)

56. $2^4$  
57. $11^2$
58. $3^6$  
59. $4^5$

**Write each power as a product of the same factor.** (Lesson 1-2)

60. $3^4$  
61. $8^5$
62. $6^2$  
63. $4^6$
64. $1^4$  
65. $9^1$

---

**Getting ready for the next lesson**

**BASIC SKILL** Divide.

66. $45 \div 15$  
67. $90 \div 5$  
68. $110 \div 10$  
69. $52 \div 4$

---

USA TODAY Snapshots

**Time spent preparing for testing**
Average class time educators say they spend annually preparing their students for state and/or national assessment tests:

- Grades 3-5: 39.4 days
- Grades 6-8: 441 days
- Grades 9-12: 30.2 days

Source: Market Data Retrieval and Education Market Research

By Cindy Hall and Bob Laird, USA TODAY
Algebra: Variables and Expressions

What You’ll LEARN
Evaluate simple algebraic expressions.

NEW Vocabulary
variable
algebraic expression
algebra
term
coefficient
constant

REVIEW Vocabulary
evaluate: find the value (Lesson 1-2)

Hands-On Mini Lab

Work with a partner.
The pattern below is made up of triangles, each with side lengths of 1.

1. Draw the next three figures in the pattern.
2. Find the perimeter of each figure and record your data in a table like the one shown below. The first three are completed for you.

<table>
<thead>
<tr>
<th>Number of Triangles</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

3. Without drawing the figure, determine the perimeter of a figure made up of 10 triangles. Check by making a drawing.
4. Find a relationship between the number of triangles and the perimeter at each stage of the pattern.

In the Mini Lab, you found that the perimeter of the figure is two more than the number of triangles. You can use a placeholder, or variable, to represent the number of triangles.

The expression \( n + 2 \) is called an algebraic expression because it contains variables, numbers, and at least one operation. The branch of mathematics that involves expressions with variables is called algebra.

Evaluate an Expression

Evaluate \( n + 3 \) if \( n = 4 \).

\[
\begin{align*}
n + 3 &= 4 + 3 \\
&= 7
\end{align*}
\]

Your Turn
Evaluate each expression if \( c = 8 \).

a. \( c + 2 \)  
   b. \( c - 3 \)  
   c. \( 15 - c \)
The following symbols are used for multiplication and division with variables. Note that the multiplication sign is usually omitted.

\[ 6d \text{ means } 6 \times d \text{ or } 6 \cdot d \]
\[ 9st \text{ means } 9 \times s \times t \]
\[ ef \text{ means } e \times f \]
\[ \frac{c}{d} \text{ means } c \div d \]

When plus or minus signs separate an algebraic expression into parts, each part is a term. The numerical factor of a term that contains a variable is called a coefficient. A term that does not contain a variable is called a constant.

Evaluate Expressions

1. Evaluate \(8w - 2v\) if \(w = 5\) and \(v = 3\).

\[
8w - 2v = 8(5) - 2(3) \quad \text{Replace } w \text{ with } 5 \text{ and } v \text{ with } 3.
= 40 - 6 \quad \text{Use the order of operations.}
= 34 \quad \text{Subtract } 6 \text{ from } 40.
\]

2. Evaluate \(\frac{mn}{6}\) if \(m = 8\) and \(n = 12\).

\[
\frac{mn}{6} = \frac{(8)(12)}{6} \quad \text{Replace } m \text{ with } 8 \text{ and } n \text{ with } 12.
= \frac{96}{6} \quad \text{The fraction bar is like a grouping symbol.}
= 16 \quad \text{Divide.}
\]

3. Evaluate \(y^2 + 2\) if \(y = 3\).

\[
y^2 + 2 = 3^2 + 2 \quad \text{Replace } y \text{ with } 3.
= 9 + 2 \text{ or } 11 \quad \text{Use the order of operations.}
\]

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

   d. \(9a - 6b\)
   e. \(\frac{ab}{2}\)
   f. \(a^2 + 5\)

Use an Expression to Solve a Problem

**HEALTH** Use the formula at the left to find Kaylee’s minimum training heart rate if she is 17 years old.

\[
(220 - a) \times 0.6 = (220 - 17) \times 0.6 \quad \text{Replace } a \text{ with } 17.
= 203 \times 0.6 \text{ or } 121.8 \quad \text{Use the order of operations.}
\]

Kaylee’s minimum training heart rate of 121.8 beats per minute is rounded up to 122 because her heart cannot beat 0.8 times.
1. Identify the coefficient and constant in the expression $2x - 6$.

2. OPEN ENDED Write an algebraic expression that involves multiplication and addition.

3. Which One Doesn’t Belong? Identify the expression that does not have the same characteristic as the other three. Explain your reasoning.

Evaluate each expression if $a = 3$, $b = 5$, and $c = 4$.

4. $a + 7$  
5. $4b$  
6. $b + c$  
7. $6c - a$  
8. $\frac{c}{4}$  
9. $\frac{5c + b}{5}$  
10. $4b^2$  
11. $\frac{3c^2}{a}$

12. What operations are used in the algebraic expression $\frac{xyz}{2}$?

13. Evaluate $n^2 + 1$ if $n = 2$.

Evaluate each expression if $d = 8$, $e = 3$, $f = 4$, and $g = 1$.

14. $d + 9$  
15. $10 - e$  
16. $4f$  
17. $8g$  
18. $f - e$  
19. $d + f$  
20. $10g - 6$  
21. $8 + 5d$  
22. $7e + 2d$  
23. $\frac{d}{5}$  
24. $\frac{16}{f}$  
25. $\frac{5d - 25}{5}$  
26. $e^2$  
27. $\frac{d^2}{2}$  
28. $6f^2$  
29. $11.9d - 10e$  
30. $\frac{2f}{g^2}$  
31. $\frac{2.5f + 5}{3}$  
32. $7e^2 + 5$  
33. $\frac{(5 + g)^2}{2}$

34. Evaluate $9h + h^2$ if $h = 3.5$.

35. For what value of $x$ is the expression $x^2$ equal to 9?

Determine whether each statement is sometimes, always, or never true. Explain.

36. The expressions $x - 3$ and $y - 3$ represent the same value.

37. The expression $ab$ means the same as the expression $a \times b$.

BASEBALL For Exercises 38–40, use the following information.

Charlie earns $16 per game for umpiring Little League baseball games.

38. Make a table that shows how much money Charlie will earn for umpiring 1, 2, 3, 4, and 5 baseball games.

39. Write an expression to find how much money Charlie will earn for any number of games. Let $n$ be the number of games he umpires.

40. Charlie umpires 18 games during the summer. How much will he earn?
Complete each table.

41. | Quarts (q) | Gallons \(\frac{q}{4}\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>?</td>
</tr>
<tr>
<td>10</td>
<td>?</td>
</tr>
<tr>
<td>12</td>
<td>?</td>
</tr>
<tr>
<td>14</td>
<td>?</td>
</tr>
</tbody>
</table>

42. | Dollars (d) | Quarters (4d) |
<table>
<thead>
<tr>
<th></th>
<th></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>?</td>
</tr>
<tr>
<td>4</td>
<td>?</td>
</tr>
<tr>
<td>5</td>
<td>?</td>
</tr>
<tr>
<td>6</td>
<td>?</td>
</tr>
</tbody>
</table>

43. **HEALTH** The expression \(110 + \frac{A}{2}\), where \(A\) stands for a person’s age, is used to estimate a person’s normal systolic blood pressure. Estimate the normal systolic blood pressure for a 16-year old.

44. **BOATING** For Exercises 44 and 45, use the information below and at the right.
The Lerman family is vacationing at the lake and wants to rent a boat.

45. Write an expression showing the cost of renting a boat for \(h\) hours.

46. **WRITE A PROBLEM** Write an algebraic expression with the variable \(x\) that has a value of 3 when evaluated.

47. **CRITICAL THINKING** Find values of \(x\) and \(y\) so that the value of \(7x + 2\) is greater than the value of \(3y + 23\).

48. **MULTIPLE CHOICE** Which expression could be used to find the cost of buying \(b\) baseball bats at $75 each and \(g\) baseball gloves at $98 each?

   - \(A\) \(75b + 98g\)
   - \(B\) \(b + g\)
   - \(C\) \(75 + 98\)
   - \(D\) \(75b ÷ 98g\)

49. **SHORT RESPONSE** Juan opened a bank account one month with $40 and deposited $15 each month after that. He was able to save $100 by December. In which month did he open the bank account?

Evaluate each expression. (Lesson 1-3)

50. \(6(5) - 2\)  
51. \(9 + 9 ÷ 3\)  
52. \(4 \cdot 2(8 - 1)\)  
53. \((17 + 3) ÷ 5\)

54. Write \(2^5\) as a product of the same factor. (Lesson 1-2)

**PREREQUISITE SKILL** Determine whether each sentence is true or false. (Lesson 1-3)

55. \(15 - 2(3) = 9\)  
56. \(20 ÷ 5 \times 4 = 1\)  
57. \(4^2 + 6 \cdot 7 = 154\)  
58. \(24 ÷ (7 - 3) = 6\)
Problem-Solving Strategy
A Preview of Lesson 1-5

What You’ll LEARN
Solve problems using the guess and check strategy.

Guess and Check

The total ticket sales for the school play were $263.50. Amber, how many adult and student tickets were sold?

Adult tickets are $7.50 and student tickets are $4.00. Also, twice as many students bought tickets as adults. Let’s guess and check to find out.

<table>
<thead>
<tr>
<th>Explore</th>
<th>We know adult tickets are $7.50, student tickets are $4.00, and twice as many students bought tickets than did adults.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>Let’s make a guess and check if it is correct. Then adjust the guess until we get the correct answer.</td>
</tr>
</tbody>
</table>
| Solve   | Make a guess.  
10 adults, 20 students  
7.5(10) + 4(20) = $155  
too low  
Adjust the guess upward.  
20 adults, 40 students  
7.5(20) + 4(40) = $310  
too high  
Adjust the guess downward slightly.  
18 adults, 36 students  
7.5(18) + 4(36) = $279  
still too high  
Adjust the guess downward again.  
17 adults, 34 students  
7.5(17) + 4(34) = $263.50  
correct  
There were 17 adult and 34 student tickets sold. |
| Examine | Seventeen adult tickets cost $127.50, and 34 student tickets cost $136. Since $127.50 + $136 = $263.50 and 34 tickets are twice as many as 17 tickets, the guess is correct. |

Analyze the Strategy

1. **Explain** why you must keep a careful record of each of your guesses and their results in the solve step of the problem-solving plan.

2. **Write** a problem that could be solved by guess and check. Then write the steps you would take to find the solution to your problem.
5. **MUSIC** Flor is burning a CD for her friend Derek. The CD will hold 30 minutes of music. Which songs should she select from the list at the right to record the maximum time on the CD without going over?

<table>
<thead>
<tr>
<th>SONG</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3 min 30 s</td>
</tr>
<tr>
<td>B</td>
<td>6 min 0 s</td>
</tr>
<tr>
<td>C</td>
<td>4 min 45 s</td>
</tr>
<tr>
<td>D</td>
<td>5 min 30 s</td>
</tr>
<tr>
<td>E</td>
<td>5 min 6 s</td>
</tr>
<tr>
<td>F</td>
<td>4 min 15 s</td>
</tr>
<tr>
<td>G</td>
<td>4 min 30 s</td>
</tr>
<tr>
<td>H</td>
<td>3 min 48 s</td>
</tr>
</tbody>
</table>

6. **NUMBER THEORY** A number is squared, and the result is 256. Find the number.

7. ** PATTERNS** Copy the table below. Extend the pattern to complete the table.

<table>
<thead>
<tr>
<th>Input</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>1</td>
<td>8</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. **MULTI STEP** The Wicked Twister roller coaster can accommodate about 1,000 passengers per hour. The coaster has 8 vehicles that each carry 4 passengers. Approximately how many runs are made in 1 hour?

9. **PHYSICAL SCIENCE** Telephone calls travel through optical fibers at the speed of light, which is 186,000 miles per second. A millisecond is 0.001 of a second. How far can your voice travel over an optical line in 1 millisecond?

4. **SOUVENIRS** The Pike’s Peak souvenir shop sells standard-sized postcards in packages of 5 and large-sized postcards in packages of 3. If Juan bought 16 postcards, how many packages of each did he buy?

10. **MONEY MATTERS** Syreeta needs to buy four markers to make posters for a science project. She has $4. Does she have enough money if the cost of each marker, including tax, is 89¢? Explain.

**SNOWFALL** For Exercises 11 and 12, use the graph below.

**Lesson 1-5a** Problem-Solving Strategy: Guess and Check
**Algebra: Equations**

**BASKETBALL** The table shows the number of wins for six WNBA teams after playing 34 games each.

1. How many losses did each team have?

2. Write a rule to describe how you found the number of losses.

3. Let \( w \) represent the number of wins and \( l \) represent the number of losses. Rewrite your rule using numbers, variables, and an equals sign.

<table>
<thead>
<tr>
<th>Team</th>
<th>Wins</th>
<th>Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detroit</td>
<td>25</td>
<td>?</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>24</td>
<td>?</td>
</tr>
<tr>
<td>Houston</td>
<td>20</td>
<td>?</td>
</tr>
<tr>
<td>Charlotte</td>
<td>18</td>
<td>?</td>
</tr>
<tr>
<td>New York</td>
<td>16</td>
<td>?</td>
</tr>
<tr>
<td>Phoenix</td>
<td>8</td>
<td>?</td>
</tr>
</tbody>
</table>

Source: wnba.com

An **equation** is a sentence in mathematics that contains an equals sign. The equals sign tells you that the expression on the left is equivalent to the expression on the right.

\[ 4 + 3 = 8 - 1 \quad 3(4) = 24 \div 2 \quad 17 = 13 + 2 + 2 \]

An equation that contains a variable is neither true nor false until the variable is replaced with a number. The **solution** of an equation is a number that makes the sentence true.

The process of finding a solution is called **solving an equation**. Some equations are easy to solve using mental mathematics.

**Example**

**Solve an Equation Mentally**

1. Solve \( 18 = 14 + t \) mentally.

   \[ 18 = 14 + t \quad \text{Write the equation.} \]
   \[ 18 = 14 + 4 \quad \text{You know that} \ 14 + 4 \ \text{is} \ 18. \]
   \[ 18 = 18 \quad \text{Simplify.} \]

   The solution is 4.

**Your Turn** Solve each equation mentally.

- **a.** \( p - 5 = 20 \)
- **b.** \( 8 = y \div 3 \)
- **c.** \( 7h = 56 \)
Graph the Solution of an Equation

Graph the solution of the equation in Example 1.
Locate the point named by the solution on a number line. Then draw a dot at the solution, 3.

---

When you write an equation that represents a real-life problem, you are modeling the problem. First, choose a variable to represent one of the unknowns. This is called defining the variable.

Write an Equation to Solve a Problem

**FOOD** The total cost of a hamburger, fries, and soft drink is $5.50. If the fries and drink cost $2.50 together, what is the cost of the hamburger?

<table>
<thead>
<tr>
<th>Words</th>
<th>The cost of a hamburger, fries, and soft drink is $5.50.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Let ( h ) represent the cost of the hamburger.</td>
</tr>
<tr>
<td>Equation</td>
<td>( h + 2.50 = 5.50 )</td>
</tr>
</tbody>
</table>

\( h + 2.50 = 5.50 \) Write the equation.

\( 3 + 2.50 = 5.50 \) Replace \( h \) with 3 to make the equation true.

\( 5.50 = 5.50 \) Simplify.

The number 3 is the solution of the equation. So, the cost of the hamburger is $3.00.

Find a Solution of an Equation

**MULTIPLE-CHOICE TEST ITEM**

What value of \( x \) is a solution of \( x + 14.6 = 30.2 \)?

- A 14.9
- B 15.2
- C 15.6
- D 16.1

**Read the Test Item**

Substitute each value for \( x \) to determine which makes the left side of the equation equivalent to the right side.

**Solve the Test Item**

Replace \( x \) with 14.9. Replace \( x \) with 15.2. Replace \( x \) with 15.6.

\[
\begin{align*}
14.9 + 14.6 & \neq 30.2 \\
15.2 + 14.6 & \neq 30.2 \\
15.6 + 14.6 & = 30.2
\end{align*}
\]

29.5 \( \neq \) 30.2 false 29.8 \( \neq \) 30.2 false 30.2 = 30.2 true

The value 15.6 makes the equation true. So, the answer is C.
1. Explain what it means to solve an equation.

2. OPEN ENDED Write an example of an equation that is easily solved using mental mathematics and an equation that is not as easily solved using mental mathematics.

3. FIND THE ERROR Joshua and Ivan had a contest to see who could solve $w - 25 = 50$ the fastest. Their solutions are shown below. Who is correct? Explain.

   \[
   \begin{align*}
   \text{Joshua} & : w = 25 \\
   \text{Ivan} & : w = 75
   \end{align*}
   \]

Solve each equation mentally.

4. $y - 18 = 20$  
5. $5 + a = 22$  
6. $w \div 4 = 7$  
7. $\frac{r}{9} = 6$  
8. $75 = w + 72$  
9. $69 = 3f$

10. Graph the solution of $x + 5 = 11$.

Name the number that is the solution of the given equation.

11. $x + 15 = 19; 4, 5, 6$  
12. $13k = 80.6; 5.5, 5.8, 6.2$

13. BASKETBALL Jason scored 14 more points than David in the last basketball game. If David scored 9 points, how many did Jason score?

Solve each equation mentally.

14. $b + 7 = 18$  
15. $8 + x = 15$  
16. $y - 15 = 71$  
17. $a - 18 = 20$  
18. $25 - 19 = n$  
19. $24 + 39 = m$  
20. $12 \cdot 5 = s$  
21. $n = \frac{30}{6}$  
22. $b - 42 = 84$  
23. $7t = 77$  
24. $3d = 99$  
25. $22 + h = 42$  
26. $20 = y \div 5$  
27. $16 = \frac{u}{4}$  
28. $\frac{z}{7} = 12$  
29. $18j = 360$  
30. $m - 36 = 123$  
31. $108 = 9b$

Graph the solution of each equation on a number line.

32. $w + 3 = 10$  
33. $x - 7 = 11$  
34. $12y = 48$  
35. $11 = 132 \div z$

Name the number that is the solution of the given equation.

36. $13.4 \cdot 9 = h; 117.8, 118.7, 120.6$  
37. $n \div 10 = 4; 20, 30, 40$  
38. $9.9 + r = 24.2; 12.7, 14.3, 16.3$  
39. $c - 8 = 17; 15, 25, 35$

40. ORNAMENTS Last year, Desiree had 25 glass ornaments. This year, she has 38 ornaments. Solve $25 + n = 38$ to find how many new ornaments Desiree collected.
41. **MONEY** Maria was paid $9 per hour and earned $67.50. How many hours did she work? Use the equation \(67.50 = 9h\), where \(h\) is hours worked.

**WHALES** For Exercises 42 and 43, use the information below.
Each winter, Humpback whales migrate about 1,500 miles north to the Indian Ocean. However, scientists tracked one whale that migrated 5,000 miles in one season.

42. Write an equation that can be used to find how many more miles the whale migrated compared to the usual migration.
43. How much farther did the whale travel than the usual migration?

44. **MULTI STEP** A long-running TV show aired 179 episodes from October 1951 to September 1961. About how many episodes were filmed each year?

45. **PENGUINS** On average, how much taller are Emperor penguins than Adelie penguins? Write an equation and solve.

46. **BASKETBALL** During one game of his rookie year, LeBron James scored 41 of the Cleveland Cavalier’s 107 points. How many points did the rest of the team score?

47. **CRITICAL THINKING** Consider the equation \(0 \times a = b\). Find the values of \(a\) and \(b\).

48. **MULTIPLE CHOICE** Choose the solution of the equation \(\frac{48}{c} = 4 + 2\).

- A 2
- B 4
- C 6
- D 8

49. **GRID IN** Use the table to determine how much farther in air miles Phoenix is from New Orleans than Memphis.

<table>
<thead>
<tr>
<th>Distance (air mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memphis, TN to New Orleans, LA: 358</td>
</tr>
<tr>
<td>Phoenix, AZ to New Orleans, LA: 1,316</td>
</tr>
</tbody>
</table>

50. **ALGEBRA** Evaluate \(3a + b^2\) if \(a = 2\) and \(b = 3\). (Lesson 1-4)

Evaluate each expression. (Lesson 1-3)

51. \(11 \cdot 6 \div 3 + 9\)
52. \(5 \cdot 13 - 62\)
53. \(1 + 2(8 - 5)^2\)

54. **DINING** Four hundred sixty people are scheduled to attend a banquet. If each table seats 8 people, how many tables are needed? (Lesson 1-1)

55. **BASIC SKILL** Multiply.

- 2 \((9 + 10)\)
- (9 \cdot 1) \cdot 8
- (5 \cdot 3)(5 \cdot 2)
- (6 + 8) \cdot 12
1. List the steps in the four-step problem-solving plan. *(Lesson 1-1)*

2. **OPEN ENDED** Write an algebraic expression and identify any coefficients, variables, and constants. *(Lesson 1-4)*

3. **SPORTS** A baseball stadium holds 20,000 people. If 3,650 people can be seated in the bleachers, how many seats are available in the rest of the stadium? *(Lesson 1-1)*

4. Write $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ in exponential form. *(Lesson 1-2)*

Evaluate each expression. *(Lessons 1-2 and 1-3)*

5. $4^5$  
6. $9^6$  
7. $3^{10}$  
8. $25 - (3 + 2 \cdot 5)$  
9. $(3^3 + 4) + 3^2$  
10. $\frac{2(7 - 3)}{2^2}$

Evaluate each expression if $x = 12$, $y = 4$, and $z = 8$. *(Lesson 1-4)*

11. $x - 5$  
12. $3y + 10z$  
13. $\frac{yz}{2}$  
14. $\frac{(y + 8)^2}{x}$

Solve each equation mentally. *(Lesson 1-5)*

15. $x + 16 = 23$  
16. $36 = 3y$  
17. $\frac{65}{z} = 5$

18. **GEOMETRY** The perimeter of a rectangle is given by the expression $2(\ell + w)$ where $\ell = \text{length}$ and $w = \text{width}$. Find the perimeter of the rectangle. *(Lesson 1-4)*

19. **MULTIPLE CHOICE** A cycling club is planning a 1,800-mile trip. They can average 15 miles per hour for 6 hours each day. How many days will it take them to complete the trip? *(Lesson 1-1)*

   - [ ] 20 days
   - [ ] 21 days
   - [ ] 22 days
   - [ ] 23 days

20. **GRID IN** The expression $\frac{w}{30'}$ where $w$ is a person’s weight in pounds, is used to find the approximate number of quarts of blood in the person’s body. How much blood does a 120-pound person have? *(Lesson 1-4)*
Express Yourself!

GET READY!

Players: two, three, or four
Materials: scissors, 18 index cards cut in half, one number cube

GET SET!

• On each card, write a different expression containing only one variable. The coefficients and constants are to be values less than or equal to ten and any exponents should be less than four. Four examples are shown at the right.

GO!

• Deal all cards to the players. The dealer then rolls the number cube. The number rolled is the value of the variable for the first round.
• The player to the left of the dealer puts a card of his or her choice faceup on the table, evaluates the expression on the card, and announces its value. Play continues until all players have placed one card on the table. This is the end of the first round. The person whose card has the greatest value wins all of the cards for that round.
• The player to the left of the dealer rolls the number cube. This is the value of the variable for the next round. Play continues until all the cards are played.
• Who wins? The person who has the most cards at the end of the game is the winner.
What You’ll LEARN

Use addition and multiplication properties to solve problems.

NEW Vocabulary

equivalent expressions
properties

Link to READING

Everyday Meaning of Distribute: to divide among several, as in distribute a deck of cards

RESTAURANTS Land-Ho! Fish Market is having a Friday night special.

1. Find the total cost for a 5-member family, without tax and tip, if each one orders a fish-bake dinner and cheesecake.

2. Describe the method used to find the total cost.

3. Is there more than one way to find the total cost?

Here are two ways to find the total cost of the dinner:

The expressions $5(8.95 + 2.15)$ and $5(8.95) + 5(2.15)$ are equivalent expressions because they have the same value, $55.50. This shows how the Distributive Property combines addition and multiplication.

Key Concept: Distributive Property

To multiply a sum by a number, multiply each addend of the sum by the number outside the parentheses.

Words

Symbols

Arithmetic

Algebra

$3(4 + 6) = 3(4) + 3(6)$

$a(b + c) = a(b) + a(c)$

Use the Distributive Property

Use the Distributive Property to write each expression as an equivalent expression. Then evaluate the expression.

1. $5(3 + 2)$

$5(3 + 2) = 5 \cdot 3 + 5 \cdot 2$

$= 15 + 10 \quad \text{Multiply.}$

$= 25 \quad \text{Add.}$

2. $(7 + 4)3$

$(7 + 4)3 = 7 \cdot 3 + 4 \cdot 3$

$= 21 + 12 \quad \text{Multiply.}$

$= 33 \quad \text{Add.}$
Use the Distributive Property

**HISTORY** The Pony Express riders carried mail from St. Joseph, Missouri, to Sacramento, California, in eight days. On average, the riders covered 250 miles each day. About how far did the Pony Express riders travel over the eight-day period?

You can find how many miles the riders traveled over the eight-day period by finding $8 \times 250$. You can use the Distributive Property to multiply mentally.

\[
8(250) = 8(200 + 50) \quad \text{Rewrite 250 as 200 + 50.}
\]
\[
= 8(200) + 8(50) \quad \text{Distributive Property}
\]
\[
= 1,600 + 400 \quad \text{Multiply.}
\]
\[
= 2,000 \quad \text{Add.}
\]

So, the riders on the Pony Express traveled about 2,000 miles over an eight-day period.

**Properties** are statements that are true for any number or variable.

### Key Concept: Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commutative</strong></td>
<td>The order in which two numbers are added or multiplied does not change their sum or product.</td>
</tr>
<tr>
<td><strong>Associative</strong></td>
<td>The way in which three numbers are grouped when they are added or multiplied does not change their sum or product.</td>
</tr>
<tr>
<td><strong>Identity</strong></td>
<td>The sum of an addend and 0 is the addend. The product of a factor and 1 is the factor.</td>
</tr>
</tbody>
</table>

### Identify Properties

Name the property shown by each statement.

1. $6 + (2 + 7) = (6 + 2) + 7$  
   - Associative Property of Addition

2. $15 \times 10 = 10 \times 15$  
   - Commutative Property of Multiplication

3. $4 \times 1 = 4$  
   - Identity Property of Multiplication

4. $4(6 + 8) = 4(6) + 4(8)$  
   - Distributive Property

### Your Turn

Name the property shown by each statement.

a. $1 \times (3 \times 4) = (1 \times 3) \times 4$  
   - Associative Property of Multiplication

b. $a + 0 = a$  
   - Identity Property of Addition
1. **Rewrite** \( p(q) + p(r) \) using the Distributive Property.

2. **OPEN ENDED** Write an equation that illustrates the Associative Property of Addition.

3. **NUMBER SENSE** True or False? Explain your answer.
   \((11 + 18) \times 5 = 11 + 18 \times 5\)

---

**GUIDED PRACTICE**

Use the Distributive Property to write each expression as an equivalent expression. Then evaluate the expression.

4. \( 7(4 + 3) \)  
5. \( (10 + 8)2 \)  
6. \( 5(6 - 2) \)

Name the property shown by each statement.

7. \( 5 + 4 = 4 + 5 \)  
8. \( (2 \times 3) \times 7 = 2 \times (3 \times 7) \)  
9. \( 6(9 + 3) = 6(9) + 6(3) \)  
10. \( 5 \times 1 = 5 \)

---

**Practice and Applications**

Use the Distributive Property to write each expression as an equivalent expression. Then evaluate the expression.

11. \( 2(6 + 7) \)  
12. \( (3 + 8)4 \)  
13. \( (11 + 3)8 \)

14. \( 2(5 - 4) \)  
15. \( 7(8 - 6) \)  
16. \( 6(12 + 5) \)

17. Which expression is easier to evaluate mentally: \( 3(452) \) or \( 3(400 + 50 + 2) \)? Explain.

18. Is \( 5 + 15 = 5(1 + 3) \) a true equation? Explain your reasoning.

Name the property shown by each statement.

19. \( 1 \times (5 \times 9) = (1 \times 5) \times 9 \)  
20. \( 4 + b = b + 4 \)

21. \( m \times n = n \times m \)  
22. \( 8 + 0 = 8 \)

23. \( (1 + r) + s = 1 + (r + s) \)  
24. \( (2.5 + 7)e = 2.5e + 7e \)

25. \( x(y + z) = xy + xz \)  
26. \( 19 \times 1 = 19 \)

---

**TRAVEL** For Exercises 27 and 28, use the table at the right.

27. Write a sentence comparing the mileage from Jacksonville to Charleston to Norfolk and the mileage from Norfolk to Charleston to Jacksonville.

28. Name the property that is shown in the sentence.

**COIN COLLECTING** Mrs. Jackson has collected 152 rare coins.

29. If she does not add any coins to her collection, write a sentence that represents this situation.

30. Name the property that is illustrated.
Use properties to rewrite each expression as an equivalent expression without parentheses.

31. \((y + 1) + 4\)  
32. \(2 + (x + 4)\)  
33. \(4(8b)\)  
34. \((3a)2\)  
35. \(2(x + 3)\)  
36. \(4(2 + b)\)  
37. \(6(c + 1) - c\)  
38. \(3(f + 4) + 2f\)  

39. **MENTAL MATH** Use one of the properties to find \(6(48)\) mentally. Which property did you use?

40. **BASKETBALL** Use mental math to find the total number of NBA draftees that have come from the schools in the graph.

41. **WRITE A PROBLEM** Write about a real-life situation that can be solved using the Distributive, Commutative, Associative, or Identity Properties. Then use the property to solve the problem.

42. **CRITICAL THINKING** A counterexample is an example showing that a statement is not true. Provide a counterexample to the following statement. *Division of whole numbers is associative.*

43. **MULTIPLE CHOICE** Rewrite \(p \times (q \times r)\) using the Associative Property.

A. \((p \times q) \times r\)  
B. \(p \times q \times r\)  
C. \((p + q) \times r\)  
D. \(p \times q \times r \times 1 = p \times q \times r\)

44. **SHORT RESPONSE** Rewrite \(6(9 + 8)\) using the Distributive Property.

Name the number that is the solution of the given equation. *(Lesson 1-5)*

45. \(x + 12 = 20; 8, 9, 10\)  
46. \(7.3 = t - 4; 10.3, 11.3, 12.3\)  
47. \(35.5 = 5n; 5.1, 7.1, 9.1\)  
48. \(z \div 6 = 18; 88, 98, 108\)

**LIFE SCIENCE** For Exercises 49 and 50, use the information below.
It is believed that a dog ages 7 human years for every calendar year. *(Lesson 1-4)*

49. Write an expression for determining a dog’s age in human years. Let \(y\) represent the number of calendar years the dog has lived.

50. Find the human age of a dog that has lived for 12 calendar years.

51. Evaluate \((14 - 9)^4\). *(Lesson 1-3)*

**GETTING READY FOR THE NEXT LESSON**

**BASIC SKILL** Find the next number in each pattern.

52. 2, 4, 6, 8, ?  
53. 10, 21, 32, 43, ?  
54. 1.4, 2.2, 3.0, 3.8, ?

55. 4, 8, 12, 16, ?  
56. 64, 32, 16, 8, ?  
57. 0.4, 1.2, 3.6, 10.8, ?
Sequences

What You’ll LEARN
Recognize and extend patterns for sequences.

NEW Vocabulary
sequence
term
arithmetic sequence
geometric sequence

Link to READING
Everyday Meaning of Sequence: a connected series, as in a sequence of events

Work with a partner.

A diagonal connects two nonconsecutive vertices in a figure, as shown at the right.

1. Draw a six-sided figure and all of its diagonals.
2. How many diagonals does the figure have?
3. Describe the pattern formed by the number of diagonals: 0, 2, 5, 9, …
4. Make a prediction about how many diagonals a 7-sided, an 8-sided, and a 9-sided figure would have.

A sequence is an ordered list of numbers. Each number in a sequence is called a term.

Describe Patterns in Sequences

Describe the pattern in each sequence and identify the sequence as arithmetic, geometric, or neither.

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Pattern Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 13, 18, 23, …</td>
<td>Each term is found by adding 5 to the previous term. This sequence is arithmetic.</td>
</tr>
<tr>
<td>1, 4, 16, 64, …</td>
<td>Each term is found by multiplying the previous term by 4. This sequence is geometric.</td>
</tr>
</tbody>
</table>

Each term is found by adding 5 to the previous term. This sequence is arithmetic.

Each term is found by multiplying the previous term by 4. This sequence is geometric.

Describe the pattern in each sequence and identify the sequence as arithmetic, geometric, or neither.

a. 4, 12, 36, 108, …

b. 1, 2, 4, 7, 11, …
If you know the pattern of a sequence, you can use it to determine the terms.

**Determine Terms in Sequences**

Write the next three terms of each sequence.

1. **0, 13, 26, 39, ...**

   Each term is 13 greater than the previous term.
   
   Continue the pattern to find the next three terms.
   
   $39 + 13 = 52 \quad 52 + 13 = 65 \quad 65 + 13 = 78$
   
   The next three terms are 52, 65, and 78.

2. **0.16, 0.8, 4, 20, 100, ...**

   Each term is 5 times the previous term.
   
   Continue the pattern to find the next three terms.
   
   $20 \times 5 = 100 \quad 100 \times 5 = 500 \quad 500 \times 5 = 2,500$
   
   The next three terms are 100, 500, and 2,500.

3. **0.5, 1.5, 2.5, 3.5, ...**

4. **0.5, 1, 2, 4, ...**

   
**Your Turn** Write the next three terms of each sequence.

   c. 0.5, 1.5, 2.5, 3.5, ...
   d. 0.5, 1, 2, 4, ...

---

**Skill and Concept Check**

1. **Writing Math** Compare and contrast arithmetic and geometric sequences.

2. **Explain** how you would find the next term in the sequence

   14, 22, 30, 38, 46, ...

3. **OPEN ENDED** Write five terms of an arithmetic sequence and describe the rule for finding the terms.

   Describe the pattern in each sequence and identify the sequence as arithmetic, geometric, or neither.

   4. **0, 9, 18, 27, ...**  
   5. **200, 202, 206, 212, ...**  
   6. **36, 144, 576, 2,304, ...**

   Write the next three terms of each sequence.

   7. **4, 12, 36, 108, ...**  
   8. **22, 33, 44, 55, ...**  
   9. **5, 5.4, 5.8, 6.2, ...**

   10. Find the missing terms in the sequence 26, 33, 40, ____, 54, 61, ____, ... .

   11. Create a sequence of four terms in which the first term is 70 and the next terms are found by multiplying 0.1.
Describe the pattern in each sequence and identify the sequence as arithmetic, geometric, or neither.

12. 1, 6, 36, 216, … 13. 19, 31, 43, 55, …
14. 2, 14, 98, 686, … 15. 3.5, 10.5, 31.5, 94.5, …
16. 2.0, 3.1, 4.2, 5.3, … 17. 1, 2, 6, 24, 120, …

Write the next three terms of each sequence.

18. 33, 38, 43, 48, … 19. 4.6, 8.6, 12.6, 16.6, … 20. 0.05, 0.4, 3.2, 25.6, …
21. 0.1, 0.4, 0.7, 1.0, … 22. 3, 12, 48, 192, … 23. 125, 25, 5, 1, …

24. **INSECTS** Every 17 years, billions of insects called *cicada* emerge from hibernation. The last time they emerged was in 1996. Find the next three years in which they will come out of hibernation.

**GEOMETRY** For Exercises 25 and 26, use the following information.
Numbers that can be represented by a triangular arrangement of dots are called *triangular numbers*. The first five triangular numbers are shown below.

![Triangular Numbers Diagram]

25. Write a sequence formed by the first eight triangular numbers.
26. Write a rule for generating the sequence.

27. **CRITICAL THINKING** You can find any term in an arithmetic sequence by using the expression $a + (n - 1)d$, where $a$ is the first term, $d$ is the difference between each pair of consecutive terms, and $n$ is the position in the sequence. Find the eleventh term in the sequence 6, 13, 20, 27, 34, … .

28. **SHORT RESPONSE** The table shows the height of a bamboo plant after each number of hours. How tall will the plant be after 6 hours?

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Height (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
</tr>
<tr>
<td>3</td>
<td>71</td>
</tr>
</tbody>
</table>

29. **GRID IN** Find the next term in the sequence 44, 58, 72, 86, … .

Name the property shown by each statement. (Lesson 1-6)

30. $8 + 4.1 = 4.1 + 8$  
31. $3(n + 6) = 3n + 3 \cdot 6$

32. Solve $30 + y = 50$ mentally. (Lesson 1-5)

**PREREQUISITE SKILL** Multiply or divide. (Pages 560, 562)

33. $52 \times 10$  
34. $400 \div 1,000$  
35. $32 \div 10$  
36. $0.31 \times 100$
Exploring Sequences

INVESTIGATE  Work with a partner.

Fold a piece of paper in half. Make a table like the one at the right and record the number of layers of paper.

Shade one side of the folded paper.

Open the piece of paper. Record the fractional part of the paper that is not shaded. Refold the paper.

Fold your paper in half again so that the unshaded side is on the outside. Record the number of layers of paper.

Shade one side of the folded paper.

Open the piece of paper. Record the fractional part of the paper that is not shaded. Completely refold the paper.

Continue this folding, shading, and recording process for five folds.

Work with a partner.

1. Examine the sequence of numbers in the “Layers” column of your table. Is the sequence arithmetic or geometric? Then write a rule to find the next three terms.

2. Examine the sequence of numbers in the “Fraction” column of your table. Is the sequence arithmetic or geometric? Then write a rule to find the next three terms.

3. Assume you could continue the paper-folding process indefinitely. Suppose your unfolded piece of paper is 0.002 inch thick. Add a column to your table and find the thickness of the paper for the first five folds.

4. How many folds would it take until the paper is as tall as you?

5. Explain the relationship between the number of layers and the fraction of the shaded region.

What You’ll LEARN

Explore patterns in sequences using paper folding.

Materials

• calculator
• piece of paper
• recording table
• colored pencils

<table>
<thead>
<tr>
<th>Number of Folds</th>
<th>Layers of Paper</th>
<th>Fraction of Paper Not Shaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1/2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1/4</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A Follow-Up of Lesson 1-7
What You’ll LEARN
Change metric units of length, capacity, and mass.

NEW Vocabulary
meter metric system gram kilogram liter

Measurement: The Metric System

Work with a partner.
The widths of two objects are shown below.

<table>
<thead>
<tr>
<th>Object</th>
<th>Width (millimeters)</th>
<th>Width (centimeters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>computer diskette</td>
<td>?</td>
<td>8.9</td>
</tr>
<tr>
<td>CD case</td>
<td>?</td>
<td>14.4</td>
</tr>
</tbody>
</table>

1. Find three other objects. Use a ruler to find and record the width of all five objects to the nearest millimeter and tenth of a centimeter. Add your measurements to the table.

2. Compare the measurements of each object, and write a rule that describes how to convert from millimeters to centimeters.

3. Use a meterstick to measure the length of your classroom in meters. Make a conjecture about which operation you would use to convert this measure to centimeters. Explain.

The meter (m) is the base unit of length in the metric system. A meter is about the distance from the floor to a doorknob, or a little more than a yard. One kilometer is equivalent to 1,000 meters, and 1 meter is equivalent to 100 centimeters and also to 1,000 millimeters.

Metric prefixes indicate the decimal place-value position of the measurement.

Mental Math To multiply or divide by a power of ten, you can move the decimal point right or left.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning in Words</th>
<th>Meaning in Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>kilo-</td>
<td>thousands</td>
<td>1,000</td>
</tr>
<tr>
<td>centi-</td>
<td>hundredths</td>
<td>0.01</td>
</tr>
<tr>
<td>milli-</td>
<td>thousandths</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Convert Units of Length

Complete.

4.5 m = ? cm
To convert from meters to centimeters, multiply by 100.
4.5 × 100 = 450
4.5 m = 450 cm

2,600 m = ? km
To convert from meters to kilometers, divide by 1,000.
2,600 ÷ 1,000 = 2.6
2,600 m = 2.6 km
The gram (g) measures mass, the amount of matter in an object. A paper clip has a mass of about one gram. The base unit of mass in the metric system is the kilogram, which is equivalent to 1,000 grams. One gram is equivalent to 1,000 milligrams.

### Convert Units of Mass

#### Complete.

8.43 kg = \( \_\_\_\_ \) g  
To convert from kilograms to grams, multiply by 1,000.  
8.43 × 1,000 = 8,430  
8.43 kg = 8,430 g

500 mg = \( \_\_\_\_ \) g  
To convert from milligrams to grams, divide by 1,000.  
500 ÷ 1,000 = 0.5  
500 mg = 0.5 g

#### Your Turn

a. 23.5 g = \( \_\_\_\_ \) mg  
b. 9,014 g = \( \_\_\_\_ \) kg

### Convert Units of Capacity

#### Complete.

3.2 L = \( \_\_\_\_ \) mL  
To convert from liters to milliliters, multiply by 1,000.  
3.2 × 1,000 = 3,200  
3.2 L = 3,200 mL

1,640 L = \( \_\_\_\_ \) kL  
To convert from liters to kiloliters, divide by 1,000.  
1,640 ÷ 1,000 = 1.64  
1,640 L = 1.64 kL

#### Your Turn

c. 0.75 kL = \( \_\_\_\_ \) L  
d. 8,800 mL = \( \_\_\_\_ \) L

The following table is a summary of how to convert measures in the metric system.

<table>
<thead>
<tr>
<th>Units of Length</th>
<th>Larger Units → Smaller Units (multiply by a power of 10)</th>
<th>Smaller Units → Larger Units (divide by a power of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km = 1,000 m</td>
<td>1 m = 100 cm</td>
<td>1 mm = 0.1 cm</td>
</tr>
<tr>
<td>1 m = 100 cm</td>
<td>1 cm = 10 mm</td>
<td>1 cm = 0.01 m</td>
</tr>
<tr>
<td>1 cm = 10 mm</td>
<td>1 mm = 0.01 cm</td>
<td>1 m = 0.001 km</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Units of Mass</th>
<th>Larger Units → Smaller Units (multiply by a power of 10)</th>
<th>Smaller Units → Larger Units (divide by a power of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kg = 1,000 g</td>
<td>1 g = 1,000 mg</td>
<td>1 mg = 0.001 g</td>
</tr>
<tr>
<td>1 g = 1,000 mg</td>
<td></td>
<td>1 g = 0.001 kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Units of Capacity</th>
<th>Larger Units → Smaller Units (multiply by a power of 10)</th>
<th>Smaller Units → Larger Units (divide by a power of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kL = 1,000 L</td>
<td>1 L = 1,000 mL</td>
<td>1 mL = 0.001 kL</td>
</tr>
<tr>
<td>1 L = 1,000 mL</td>
<td></td>
<td>1 L = 0.001 kL</td>
</tr>
</tbody>
</table>

The liter (L) is widely used and accepted as the metric measure for capacity. Capacity is the amount of dry or liquid material an object can hold. Some soft drinks are sold in one-liter bottles. Kiloliter, liter, and milliliter are related in a manner similar to kilometer, meter, and millimeter.
1. **Writing Math** Explain why it makes sense to multiply when changing from a larger unit to a smaller unit.

2. **OPEN ENDED** List a set of measurement references, made up of everyday objects, that will help you remember the basic units in the metric system.

3. **FIND THE ERROR** Hunter and Arturo are converting 45.7 milligrams to grams. Who is correct? Explain.

Hunter: 45.7 mg = 0.0457 g
Arturo: 45.7 mg = 45,700 g

Complete.

4. 550 m = ___ km  
5. 45 g = ___ mg  
6. 1,460 mL = ___ L  
7. 3.7 m = ___ cm  
8. 3,800 mg = ___ g  
9. 2.34 kL = ___ L  

10. How many milliliters are in 0.04 liter?

Practice and Applications

Complete.

11. 720 cm = ___ m  
12. 983 mm = ___ m  
13. 64 kg = ___ g  
14. 7.5 g = ___ mg  
15. 925 mg = ___ g  
16. 345 mL = ___ L  
17. 0.85 cm = ___ mm  
18. 3.2 m = ___ cm  
19. 9.1 L = ___ mL  
20. 73.2 g = ___ mg  
21. 43 L = ___ kL  
22. 130.5 kL = ___ L  
23. 997 g = ___ kg  
24. 0.046 kL = ___ L  
25. 82.1 g = ___ kg  
26. 0.03 m = ___ mm  
27. 57,000 mL = ___ L  
28. 0.22 mm = ___ cm

**MONUMENTS** For Exercises 29 and 30, use the information about the Washington Monument at the right.

29. What is the height of the monument in kilometers?
30. What is the height in centimeters? in millimeters?

31. Order 0.02 km, 50 m, and 3,000 cm from least to greatest length.
32. Order 0.05 kg, 32 g, and 430,000 mg from greatest to least mass.
33. Order 660 mL, 0.06 L, and 6.6 kL from least to greatest capacity.

Complete.

34. 0.05 km = ___ mm  
35. 0.93 km = ___ cm  
36. 23,000 mg = ___ kg  
37. 40,000 mL = ___ kL
38. **TRACK AND FIELD** Refer to the table. Convert the distance of each event to kilometers.

39. **MULTI STEP** Heather needs a 2.5-meter pole for a birdfeeder that she is building. How many centimeters will she need to cut off a 3-meter pole in order to use it for the birdfeeder?

40. **MULTI STEP** Margarita is running the school concession stand. The fruit punch machine holds 15 liters. Each drink cup holds 500 milliliters of punch. How many cups of punch can Margarita sell before the fountain is empty?

41. **BAKING** Evan is making peach cobbler for the fair. The recipe requires 900 grams of peaches per cobbler. If Evan has 4.5 kilograms of peaches, how many cobbler can he make?

42. **RESEARCH** Use the Internet or another source to investigate relationships between metric units of mass and capacity. Explain the relationships and give examples of how they are used in real life.

**CRITICAL THINKING** The metric prefix *giga* refers to something that is one billion times larger than the base unit. The metric prefix *nano* refers to something that is one billion times smaller than the base unit.

43. How many meters are in 3.9 gigameters?

44. How many meters are in 3.9 nanometers?

---

45. **MULTIPLE CHOICE** Choose the best estimate for the mass of a golf ball.

- (A) 4.5 mg
- (B) 4.5 g
- (C) 45 g
- (D) 45 kg

46. **GRID IN** What is the mass in grams of a 200-milligram dosage of medication?

Describe the pattern in each sequence and identify the sequence as *arithmetic*, *geometric*, or *neither*. (Lesson 1-7)

47. 27, 36, 45, 54, ...

48. 6, 36, 216, 1,296, ...

49. 1.1, 2.2, 3.3, ...

50. 1, 4, 9, 16, ...

Use the Distributive Property to write each expression as an equivalent expression. Then evaluate the expression. (Lesson 1-6)

51. 5(9 + 7)

52. (12 + 4)4

53. 8(7 − 2)

54. (6 − 5)10

---

**PREREQUISITE SKILL** Multiply. (Lesson 1-3)

55. 8 · 10^2

56. 5 · 10^3

57. 4 · 10^5

58. 2.7 · 10^3

59. 65 · 10^2

60. 1.35 · 10^4
Use Power Notes

Power notes are similar to lesson outlines, but they are simpler to organize. Power notes use the numbers 1, 2, 3, and so on.

**Power 1:** This is the main idea.

**Power 2:** This provides details about the main idea.

**Power 3:** This provides details about Power 2.

and so on....

Here’s a sample of power notes from Lesson 1-8. Notice that you can even add drawings or examples to your power notes.

1. The Metric System
2. Length
3. Units of Length
   4. meter – basic unit
   4. 1 kilometer = 1,000 meters
   4. 1 centimeter = 0.01 meter
   4. 1 millimeter = 0.001 meter
3. Converting Units of Length
   4. from larger to smaller – multiply
   4. from smaller to larger – divide

You can have more than one detail under each power.

2. Mass

**SKILL PRACTICE**

1. Explain why the four-step plan in Lesson 1-1 is a form of power notes.
2. Complete the power notes above for units of mass and capacity.

*Use power notes to make an outline for each concept.*

3. order of operations (Hint: See Lesson 1-3.)
4. addition and multiplication properties (Hint: See Lesson 1-6.)
5. algebraic and geometric sequences (Hint: See Lesson 1-7.)
Scientific Notation

am I ever going to use this?

ENTERTAINMENT  The Mall of America in Bloomington, Minnesota, is the largest shopping and entertainment center in the United States. The table shows two features of the mall.

1. Complete the table.
2. Write both numbers as the product of a number and a power of ten.
3. Rewrite both powers of ten using exponents.

When you work with very large numbers, it is difficult to keep track of the place value. You can write numbers like 4.2 million in scientific notation by using a power of ten.

\[ 4.2 \text{ million} = 4.2 \times 1,000,000 = 4.2 \times 10^6 \]

\[ 10^6 = 1,000,000 \]

In Lesson 1-3, you used the order of operations to evaluate expressions like \( 5.2 \times 10^5 \). You can also use the order of operations to write a number in standard form.

Write a Number in Standard Form

Write \( 5.2 \times 10^5 \) in standard form.

\[ 5.2 \times 10^5 = 5.2 \times 100,000 = 520,000 \]

Move the decimal point 5 places to the right.

Your Turn  Write each number in standard form.

a. \( 7.2 \times 10^4 \)  
b. \( 3.8 \times 10^9 \)  
c. \( 1.0 \times 10^8 \)
To write a number in scientific notation, move the decimal to the right of the first nonzero number. Then find the power of ten.

\[ 13,000 = 1.3 \times 10^4 \]

The decimal point was moved 4 places.

**EXAMPLE**

**Write a Number in Scientific Notation**

1. **Write 23,500,000 in scientific notation.**

   \[ 23,500,000 = 2.35 \times 10,000,000 \]

   Move the decimal point 7 places to find a number between 1 and 10.

   \[ = 2.35 \times 10^7 \]

2. **Your Turn**

   Write each number in scientific notation.
   
   - d. \( 38,000,000 \)
   - e. \( 19,000 \)
   - f. \( 86.1 \text{ billion} \)

When you use a calculator to compute large numbers, the numbers are often displayed in scientific notation.

**Compute with Large Numbers**

**RESERVOIRS** Lake Francis Case in South Dakota contains 5.7 billion cubic meters of water. Lake Mead in Nevada has about 6 times as much water. Find the approximate amount of water in Lake Mead.

To find the amount of water in Lake Mead, multiply 5.7 billion by 6.

\[ 5.7 \text{ billion} = 5,700,000,000 \]

Enter \( 5700000000 \times 6 \) on the calculator.

The number \( 3.42 \times 10^{10} \) on the calculator represents \( 3.42 \times 10^{10} \).

So, Lake Mead has about \( 3.42 \times 10^{10} \) cubic meters of water.

**Technology** To enter \( 3.42 \times 10^{10} \) on a calculator, press \( 3.42 \text{ EE } 10 \). The screen would look like this: \( 3.42 \times 10^{10} \).

**Skill and Concept Check**

1. **Writing Math** Explain why scientific notation is used with large numbers.

2. **OPEN ENDED** Write a number in standard form and then in scientific notation.

3. **NUMBER SENSE** Which number describes the population of Chicago, \( 3.0 \times 10^6 \) or \( 3.0 \times 10^3 \)? Explain your reasoning.

**GUIDED PRACTICE**

Write each number in standard form.

4. \( 5.1 \times 10^4 \)

5. \( 1.0 \times 10^5 \)

6. \( 8.05 \times 10^6 \)

Write each number in scientific notation.

7. \( 70,000 \)

8. \( 510,000 \)

9. \( 17,500,000 \)
Write each number in standard form.

10. \(4.2 \times 10^3\)  
11. \(7.3 \times 10^4\)  
12. \(6.9 \times 10^6\)  
13. \(3.38 \times 10^5\)  
14. \(1.1 \times 10^8\)  
15. \(8.98 \times 10^6\)  
16. \(5.16 \times 10^4\)  
17. \(7.98 \times 10^5\)  
18. \(1.05 \times 10^7\)  
19. \(9.90 \times 10^8\)  
20. \(5.33 \times 10^{10}\)  
21. \(8.06 \times 10^7\)

22. Triple the number 435,000 and write it in scientific notation.

23. Order the numbers 53,400, \(4.98 \times 10^6\), \(5.03 \times 10^5\), and 4,980,100 from least to greatest.

Write each number in scientific notation.

24. 46,000  
25. 19,800  
26. 169,000  
27. 9,970,000  
28. 3,720,000  
29. 505,000  
30. 607,000  
31. 23,600,000  
32. 7 million  
33. 1.1 million  
34. 40 billion  
35. 60.8 billion

NUMBER NAMES  For Exercises 36 and 37, use the table.

36. Write 13 quintillion in scientific notation.
37. Write the name of the number \(5.43 \times 10^{16}\).

Replace each \(\bullet\) with \(<\), \(>,\) or \(=\) to make a true sentence.

38. \(5,000 \bullet 5.0 \times 10^3\)  
39. \(600 \bullet 6.0 \times 10^1\)  
40. \(81,900 \bullet 8.19 \times 10^5\)  
41. \(1\) million \(\bullet 1.1 \times 10^6\)

42. GEOGRAPHY  The Mariana Trench is the deepest part of the Pacific Ocean with a depth of about 36,000 feet. Write this depth in scientific notation.

43. EARTH SCIENCE  A light-year, the distance light travels in one year, is about 5,880,000,000,000 miles. How many miles is 50 light years?

44. CRITICAL THINKING  The distance from Earth to the Sun is \(1.55 \times 10^8\) kilometers. If the speed of light is \(3 \times 10^5\) kilometers per second, about how long does it take for light to travel from the Sun to Earth? \((\text{Hint: distance} = \text{rate} \times \text{time})\)

45. MULTIPLE Choice  Asia has an area of 44,579,000 square kilometers. Write 44,579,000 in scientific notation.

\[\text{A} \ 4.4579 \times 10^6 \quad \text{B} \ 4.4579 \times 10^7 \quad \text{C} \ 4.4579 \times 10^8 \quad \text{D} \ 4.4579 \times 10^9\]

46. SHORT RESPONSE  Write the standard form of \(5.56 \times 10^{12}\).

Complete.  \((\text{Lesson 1-8})\)

47. \(1.01 \text{ kg} = \_\_\_\_ \text{ g}\)  
48. \(36 \text{ mL} = \_\_\_\_ \text{ L}\)  
49. \(2.33 \text{ km} = \_\_\_\_ \text{ m}\)

50. SOCCER  The World Cup is played every four years. If the World Cup was played in 2002, when are the next three years that it will be played? \((\text{Lesson 1-7})\)
Lesson-by-Lesson Exercises and Examples

1-1

A Plan for Problem Solving (pp. 6–9)

Use the four-step plan to solve each problem.

6. CELLULAR PHONES Sherita’s service charges a monthly fee of $20.00 plus $0.15 per minute. One monthly bill is $31.25. How many minutes did Sherita use during the month?

Example 1 Use the four-step plan to solve the problem.

GARDENING A bag of mulch covers 25 square feet of garden space. Taylor uses 7 bags of mulch to cover her garden. How large is Taylor’s garden?

Explore Taylor used 7 bags of mulch, each covering 25 square feet.

Plan Multiply 25 by 7.

Solve 25 · 7 = 175

Taylor’s garden is 175 square feet.

Examine Add 25 seven times.

7. CAR RENTAL ABC Car Rental charges $25 per day to rent a mid-sized car plus $0.20 per mile driven. Mr. Ruiz rents a mid-sized car for 3 days and drives a total of 72 miles. Find the amount of Mr. Ruiz’s bill.
Powers and Exponents (pp. 10–13)

Evaluate each expression.
8. $3^5$ 
9. $7^9$
10. $2^8$ 
11. $18^2$
12. $9^4$ 
13. $10^4$
14. $20^3$ 
15. $100^1$
16. Write $15 \cdot 15 \cdot 15$ in exponential form.

Example 2 Evaluate $4^5$.
The base is 4. The exponent 5 means that 4 is used as a factor 5 times.

$4^5 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 1,024$

Order of Operations (pp. 14–17)

Evaluate each expression.
17. $24 - 8 + 3^2$ 
18. $48 \div 6 + 2 \cdot 5$
19. $5 \cdot 9 - (2 + 3)^2$ 
20. $(14 - 4) \div 2$
21. $9 + 3(7 - 5)^3$ 
22. $12 \times 10^4$
23. $42 \div 6 - 63 \div 9$ 
24. $15 + 9 \div 3 - 7$

Example 3 Evaluate $24 - (8 \div 4)^4$.

$24 - (8 \div 4)^4 = 24 - 2^4$  Divide first since $8 \div 4$ is in parentheses.

$= 24 - 16$  Find the value of $2^4$.

$= 8$  Subtract.

Algebra: Variables and Expressions (pp. 18–21)

Evaluate each expression if $a = 10$, $b = 4$, and $c = 8$.
25. $b + 7$ 
26. $7b$
27. $(a - b)^2$ 
28. $ab \div c$
29. $3b^2 + c$ 
30. $(b + c)^2 \div 3$
31. PRODUCTION The cost of producing T-shirts is given by the expression $350 + 0.82x$, where $x$ is the number of T-shirts produced. Find the cost of producing 750 T-shirts.

Example 4 Evaluate $2m^2 - 5n$ if $m = 4$ and $n = 3$.

$2m^2 - 5n = 2(4)^2 - 5(3)$  Replace $m$ with 4 and $n$ with 3.

$= 2(16) - 5(3)$  Find the value of $4^2$.

$= 32 - 15$  Multiply.

$= 17$  Subtract.

Algebra: Equations (pp. 24–27)

Solve each equation mentally.
32. $h + 9 = 17$ 
33. $5 = c - 3$
34. $32 - 19 = w$ 
35. $8a = 56$
36. $31 - y = 8$ 
37. $\frac{1}{9} = 12$
38. $100 = 20g$ 
39. $p - 49 = 18$
40. $14 = 5 + x$  Solve $14 = 5 + x$ mentally.

Write the equation.

$14 = 5 + 9$  You know that $5 + 9 = 14$.

$14 = 14$  Simplify.

The solution is 9.
1-6  **Algebra: Properties**  (pp. 30–33)

Name the property shown by each statement.

40. \(3 + 8 = 8 + 3\)
41. \(3 \cdot (2 \cdot 7) = (3 \cdot 2) \cdot 7\)
42. \(6(1 + 4) = 6(1) + 6(4)\)
43. \(29 \cdot 1 = 29\)

**Example 6**  Name the property shown by the statement \(12 + (8 + 2) = (12 + 8) + 2\). This statement shows that the way in which three numbers are grouped when they are added does not change their sum. This is an example of the **Associative Property of Addition**.

1-7  **Sequences**  (pp. 34–36)

Describe the pattern in each sequence and identify the sequence as **arithmetic**, **geometric**, or **neither**. Then find the next three terms.

44. 5, 15, 45, 135, …
45. 2.0, 3.2, 4.4, 5.6, …
46. 1, 3, 7, 13, …
47. **CONTESTS**  The prizes for first, second, and third places in a spelling bee are $1,000, $500, and $250, respectively. If this pattern continues, what would the fourth, fifth, and sixth prizes be?

**Example 7**  Describe the pattern in the sequence 2, 4, 8, 16, 32, …, and identify the sequence as **arithmetic**, **geometric**, or **neither**. Then find the next three terms.

This is a geometric sequence created by multiplying the previous term by 2.

\[
\begin{array}{cccc}
2 & 4 & 8 & 16 \\
\times 2 & & & \\
& 16 & 32 & 64 \\
\times 2 & & & \\
& 64 & 128 & 256 \\
\end{array}
\]

The next three terms are 64, 128, and 256.

1-8  **Measurement: The Metric System**  (pp. 38–41)

Complete.

48. 3.6 km = \(?\) m
49. 29 L = \(?\) mL
50. 237 mg = \(?\) g
51. 7 mL = \(?\) L
52. 3,200 cm = \(?\) m

**Example 8**  Complete.

\(6,750 \text{ m} = \:? \text{ km}\)

Divide 6,750 by 1,000.

\[6,750 \div 1,000 = 6.75\]

So, 6,750 meters is equivalent to 6.75 kilometers.

1-9  **Scientific Notation**  (pp. 43–45)

Write each number in scientific notation.

53. 59,000
54. 84,600,000
55. 324,000
56. 10,000,000,000
57. 1,030,000
58. 333,000
59. 9.1 million
60. 6 billion

**Example 9**  Write 23,100,000 in scientific notation.

Move the decimal point 7 places to find a number between 1 and 10.

\[23,100,000 = 2.31 \times 10^7\]
1. List the order of operations used to find the value of an expression.
2. Explain the difference between an arithmetic sequence and a geometric sequence.

### Evaluate and Applications

**Evaluate each expression.**

3. \(3^5\) 
4. \(15^4\) 
5. \(18 - 3 + 5\) 
6. \(8 + (12 \div 3)^3\)

**Evaluate each expression if \(x = 12\), \(y = 5\), and \(z = 3\).**

7. \(7 - x \div z\) 
8. \(yz + 23\) 
9. \((y - z)^5\) 
10. \(\frac{xz}{y + 13}\)

**Solve each equation mentally.**

11. \(9 + m = 16\) 
12. \(d - 14 = 37\) 
13. \(23 = \frac{92}{t}\) 
14. \(6x = 126\)

**Name the property shown by each statement.**

15. \(2 + (3 + 7) = (2 + 3) + 7\) 
16. \(5(w + 2) = 5w + 10\)

**Complete.**

17. \(5.45 \text{ m} = \ ? \text{ cm}\) 
18. \(27 \text{ mL} = \ ? \text{ L}\) 
19. \(8,200 \text{ g} = \ ? \text{ kg}\)

20. **CAPACITY** The table lists the capacity of three different containers. Determine which container has the largest capacity.

<table>
<thead>
<tr>
<th>Container</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>5400 mL</td>
</tr>
<tr>
<td>#2</td>
<td>0.008 kL</td>
</tr>
<tr>
<td>#3</td>
<td>4.78 L</td>
</tr>
</tbody>
</table>

21. **ANIMALS** Irene left both her dog and cat at a kennel for 3 nights. The kennel charges $8 per night for the dog and $5 per night for the cat. Find Irene’s bill.

22. Write each number in scientific notation.

- \(42,300\) 
- \(3,780,000\) 
- \(502,000,000\)

25. Ms. Carter runs a pizza parlor. Her daily costs are $125 for rent, employee wages, and utilities, plus $2 for every pizza. If \(n\) represents the number of pizzas the pizza parlor makes one day, which expression represents Ms. Carter’s total cost for that day?

- A. \($125 + 2n\) 
- B. \(125n + 2\) 
- C. \($125n + 2n\) 
- D. \($127\)
1. The strategy of guess and check would be most useful in solving which problem? (Lesson 1-1)
   - A) About how long does it take to travel 62 miles at 58 miles per hour?
   - B) What is the area of a rectangle if it has a length of 4.5 centimeters and a width of 9 centimeters?
   - C) It costs $3 to cross the town bridge to enter town, but it is free of charge to cross it to leave town. How much does a person who makes 150 trips across the bridge into town and 50 trips across the bridge to leave town spend in bridge tolls?
   - D) The product of two consecutive even numbers is 728. Find the two numbers.

2. Ciro earns $8 per hour plus tips cleaning rooms at Sandman’s Inn. Which expression represents Ciro’s earnings for a week in which he works 36 hours and collects $25 in tips? (Lesson 1-3)
   - F) \((36 \times 8) + 25\)
   - G) \((36 + 25) \times 8\)
   - H) \((8 \times 25) + 36\)
   - I) \((36 \div 8) + 25\)

3. To estimate the number of miles a thunderstorm is from you, count the number of seconds between the thunder and the lightning. Then divide the number of seconds by 5. Which expression can be used to estimate the distance? (Lesson 1-4)
   - A) \(5 \div s\)
   - B) \(s - 5\)
   - C) \(5s\)
   - D) \(s \div 5\)

4. Which value of \(p\) makes \(64 \div p = 8\) a true sentence? (Lesson 1-5)
   - F) 2
   - G) \(2^2\)
   - H) \(2^3\)
   - I) \(3^2\)

5. Which is the graph of the solution of \(x - 15 = 33\)? (Lesson 1-5)
   - A
   - B
   - C
   - D

6. Identify the property shown by the sentence \(16 + (4 + 7) = (16 + 4) + 7\). (Lesson 1-6)
   - F) Commutative Property of Addition
   - G) Associative Property of Addition
   - H) Associative Property of Multiplication
   - I) Identity Property of Multiplication

7. Which is the next term of the sequence 6, 12, 18, 24, …? (Lesson 1-7)
   - A) 28
   - B) 30
   - C) 36
   - D) 48

8. Every morning, Morgan swims 0.5 kilometer. How many meters does she swim? (Lesson 1-8)
   - F) 5 m
   - G) 50 m
   - H) 100 m
   - I) 500 m

9. Which is 5,300,000 written in scientific notation? (Lesson 1-9)
   - A) \(0.53 \times 10^6\)
   - B) \(53 \times 10^5\)
   - C) \(5.3 \times 10^6\)
   - D) \(5.3 \times 10^7\)
Preparing for Standardized Tests
For test-taking strategies and more practice, see pages 608–625.

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

10. What value is represented by \((1 \times 10^4) + (7 \times 10^3) + (3 \times 10^2) + (0 \times 10^1)\)?
(Prerequisite Skill, p. 561)

11. The graph shows the number of World Series Championships for selected teams from 1903–2001. How many total championships have been won by these teams? (Lesson 1-1)

12. Write \(x^6\) as a product of the same factor.
(Lessons 1-2 and 1-4)

13. What is the value of \(2^2 + 4^3\)? (Lesson 1-3)

14. Tyler works at the library 3 times as many hours as Lugo and Lydia combined. Write an algebraic expression that represents the number of hours Tyler works per week if \(h\) represents the number of hours Lugo and Lydia work combined. (Lesson 1-4)

15. The town of Holden’s water tank can hold 10 kiloliters. The town of Jasper’s water tank can hold half the amount of Holden’s tank. How many liters of water can Jasper’s water tank hold? (Lesson 1-8)

16. Four countries and their approximate populations in 2001 are shown in the table. Which country has the least population? (Lesson 1-9)

<table>
<thead>
<tr>
<th>Country</th>
<th>Population, 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honduras</td>
<td>(6.7 \times 10^6)</td>
</tr>
<tr>
<td>Australia</td>
<td>(2.0 \times 10^7)</td>
</tr>
<tr>
<td>Croatia</td>
<td>(4.3 \times 10^6)</td>
</tr>
<tr>
<td>Denmark</td>
<td>(5.4 \times 10^6)</td>
</tr>
</tbody>
</table>

Source: www.factmonster.com

17. Figures 1, 2, and 3 form a pattern made of equal-sized squares. Each side of the square in Figure 1 is 2 units in length. (Lesson 1-7)

a. Extend the pattern to find the perimeters of Figures 3–8.

b. Describe the sequence of perimeters and identify the sequence as arithmetic, geometric, or neither.

c. The perimeter of a term above is given by the expression \(4f + 4\), where \(f\) is the figure number in the pattern. What is the perimeter of figure 26?

<table>
<thead>
<tr>
<th>Figure</th>
<th>Perimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>?</td>
</tr>
<tr>
<td>4</td>
<td>?</td>
</tr>
<tr>
<td>5</td>
<td>?</td>
</tr>
<tr>
<td>6</td>
<td>?</td>
</tr>
<tr>
<td>7</td>
<td>?</td>
</tr>
<tr>
<td>8</td>
<td>?</td>
</tr>
</tbody>
</table>

18. Marlene made her special punch by mixing 4 liters of ginger ale and 2,650 milliliters of cranberry juice. (Lesson 1-8)

a. How many liters are in the punch bowl when the punch is complete?

b. About how many 200-mL servings of punch can be served?