UNIT 1
Decimals, Algebra and Statistics

Chapter 1

Decimal Patterns and Algebra

Chapter 2

Statistics: Analyzing Data

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.

Nicole Duplaix/Getty Images

◄ **CONTENTS** ►

Lions, Tigers, and Bears

Math and Science 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!

WebQuest Log on to **msmath2.net/webquest** to begin your WebQuest.

1

Decimal Patterns and Algebra

"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.

Jeff Greenberg/PhotoEdit

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▶ 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 <u>tenths</u> place. (Page 555)
2. When <u>multiplying</u> 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. $32.6 \div 4$
16. $10.6 \div 2$
17. $5.5 \div 5$
18. $17.84 \div 4$

Multiply or divide. (Page 562)

19. $2.45 \times 1,000$
20. $87.3 \div 100$
21. 0.61×100
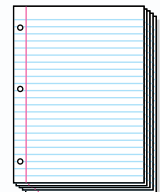22. $10 \div 1,000$

FOLDABLES Study Organizer

Decimal Patterns and Algebra Make this Foldable to help you organize your notes. Begin with ten sheets of notebook paper.
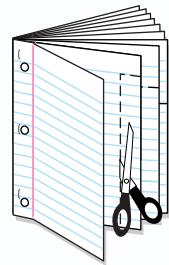
STEP 1 Staple
Staple the ten sheets together to form a booklet.
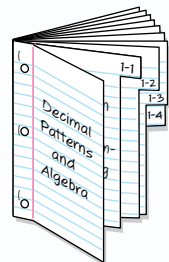
STEP 2 Cut Tabs
On the second page, make the top tab the width of the white space. On the third page, make the tab 2 lines longer, and so on.

STEP 3 Label
Write the chapter title on the cover and label each tab with the lesson number.

Noteables

Chapter Notes Each time you find this logo throughout the chapter, use your *Noteables™: Interactive Study Notebook with Foldables™* or your own notebook to take notes. Begin your chapter notes with this Foldable activity.

Math Online

Readiness To prepare yourself for this chapter with another quiz, visit **msmath2.net/chapter_readiness**
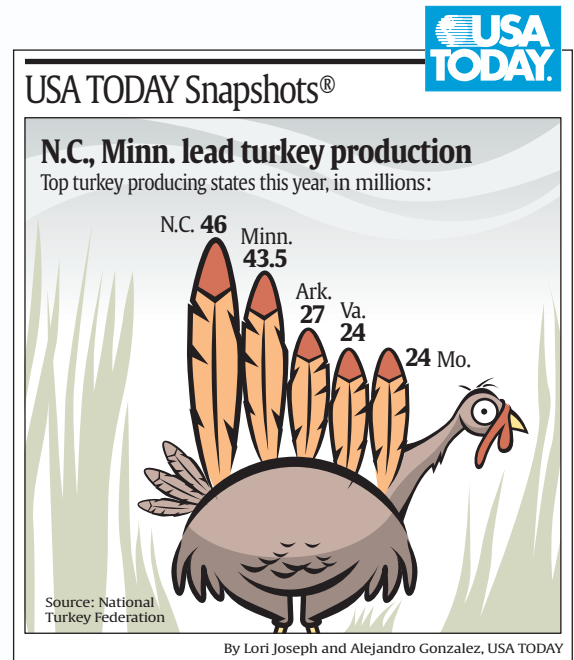
A Plan for Problem Solving

am I ever going to use this?

ANIMALS The graphic shows the top five turkey-producing states in a recent year. What is the total number of turkeys produced in the top five states?

1. Do you have all of the information necessary to solve this problem?

2. Explain how you would solve this problem. Then solve it.

3. Does your answer make sense? Explain.

4. What can you do if your first attempt at solving the problem does not work?

USA TODAY Snapshots®

N.C., Minn. lead turkey production
Top turkey producing states this year, in millions:

N.C. **46**
Minn. **43.5**
Ark. **27**
Va. **24**
24 Mo.

Source: National Turkey Federation

By Lori Joseph and Alejandro Gonzalez, USA TODAY

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.

STUDY TIP

Four-Step Plan No matter what strategy you use, you can always use the four-step plan to solve a problem.

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EXAMPLE **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?

Year	Color TVs Produced	Year	Color TVs Produced
1954	5,000	1960	120,000
1955	20,000	1961	140,000
1956	90,000	1962	450,000
1957	85,000	1963	750,000
1958	80,000	1964	1,500,000
1959	90,000		

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 $100 \times 5,000$ TVs $= 500,000$ 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.

Noteables **Key Concept: Problem-Solving Strategies**

guess and check	use a graph
look for a pattern	work backward
make an organized list	eliminate possibilities
draw a diagram	estimate reasonable answers
act it out	use logical reasoning
solve a simpler problem	make a model

EXAMPLE **Use a Strategy in the Four-Step Plan**

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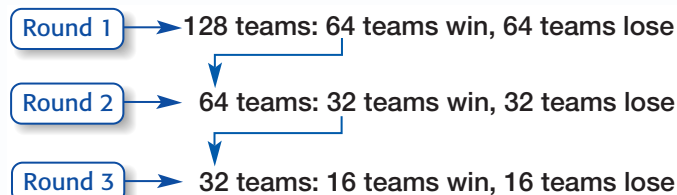
Plan You can look for a pattern by organizing the information in a table. Then continue the pattern until one team is left.

Solve

Round	1	2	3	4	5	6	7
Number of Teams	128	64	32	16	8	4	2

÷2 ÷2

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?

Skill and Concept Check

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?

Dimitri Lundt/CORBIS

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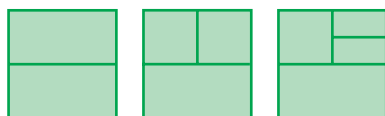
10. **MULTI STEP** Kishi wants to buy a DVD player that costs $250 with tax. So far, she has saved $145. If she saves $5 every week, in how many weeks will she be able to purchase the DVD player?

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.

Spiral Review with Standardized Test Practice

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?

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?

   Ⓐ 5   Ⓑ 50   Ⓒ 100   Ⓓ 500

Item	Cost
sweater	$29.50
gloves	$22.75
purse	$32.00
chocolates	$15.00
movie passes	$27.75

GETTING READY FOR THE NEXT LESSON

BASIC SKILL Multiply.

15. 10×10 16. $3 \times 3 \times 3$ 17. $5 \times 5 \times 5 \times 5$ 18. $2 \times 2 \times 2 \times 2 \times 2$

Powers and Exponents

What You'll LEARN

Use powers and exponents.

NEW Vocabulary

factors
exponent
base
powers
squared
cubed
evaluate
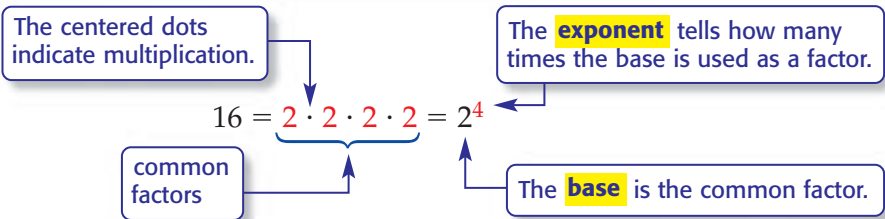standard form
exponential form

WHEN am I ever going to use this?

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?

Year	Amount of Storage Space (units)	
1	2	= 2
2	2 × 2	= 4
3	2 × 2 × 2	= 8
4	2 × 2 × 2 × 2	= 16

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.

$$16 = 2 \cdot 2 \cdot 2 \cdot 2 = 2^4$$

common factors

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.

Symbols	Words
5^2	five to the second power or five **squared**
4^3	four to the third power or four **cubed**
2^4	two to the fourth power

EXAMPLES Write Powers as Products

READING Math

First Power When a number does not have an exponent, it is understood to be 1. For example, $8 = 8^1$.

Write each power as a product of the same factor.

1 7^5

The base is 7. The exponent 5 means that 7 is used as a factor five times.

$7^5 = 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$

1 3^2

The base is 3. The exponent 2 means the 3 is used as a factor twice.

$3^2 = 3 \cdot 3$

CONTENTS

You can **evaluate**, or find the value of, powers by multiplying the factors. Numbers written without exponents are in **standard form**.

EXAMPLES **Write Powers in Standard Form**

Evaluate each expression.

1 2^5

$2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$\quad = 32$

2 4^3

$4^3 = 4 \cdot 4 \cdot 4$

$\quad = 64$

Your Turn Evaluate each expression.

a. 10^2 **b.** 7^3 **c.** 5^4

Numbers written with exponents are in **exponential form**.

EXAMPLE **Write Numbers in Exponential Form**

3 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. **Writing Math** 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.

4	9	16	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. $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$ 12. $1 \cdot 1 \cdot 1 \cdot 1$

13. Evaluate *eleven to the third power*.

CONTENTS

Practice and Applications

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. $6 \cdot 6 \cdot 6 \cdot 6 \cdot 6$

36. $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$

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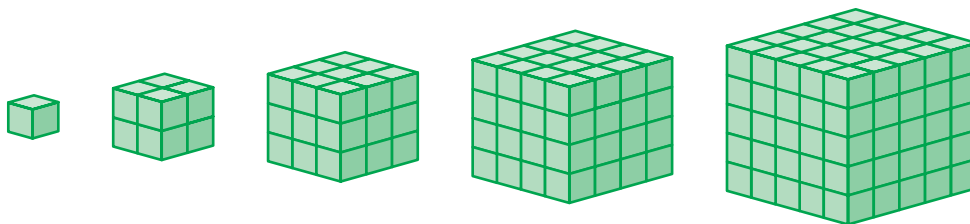
40. Find the number of unit cubes that make up each large cube. Write your answers using exponents.

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.

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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.

$$2^4 = 16$$
$$2^3 = 8$$
$$2^2 = 4$$
$$2^1 = 2$$
$$2^0 = ?$$

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)

Lucky Numbers

Source: *Indianapolis 500 Record Book*

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

68. $13.4 + 8.7$
69. $13.6 - 10.2$
70. 1.5×6.8
71. $8.6 - 5.53$
72. $36 \div 3$
73. $1.7 + 32.28$
74. 3.2×6
75. $24.5 \div 7$

Order of Operations

WHEN 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
$3 \cdot 5 - (4 + 6) = 3 \cdot 5 - 10$
$= 15 - 10 \text{ or } 5$

Percy
$3 \cdot (5 - 4) + 6 = 3 \cdot 1 + 6$
$= 3 + 6 \text{ or } 9$

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.

Noteables **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 $5 + (12 - 3)$.

$5 + (12 - 3) = 5 + 9$ Subtract first since $12 - 3$ is in parentheses.
$= 14$ Add 5 and 9.

1 Evaluate $8 - 3 \cdot 2 + 7$.
$8 - 3 \cdot 2 + 7 = 8 - 6 + 7$ Multiply 3 and 2.
$= 2 + 7$ Subtract 6 from 8.
$= 9$ Add 2 and 7.

Your Turn Evaluate each expression.

a. $39 \div (9 + 4)$ b. $10 + 8 \div 2 - 6$

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EXAMPLES **Evaluate Expressions with Powers**

1 **Evaluate 15×10^3.**

$15 \times 10^3 = 15 \times 1,000$ Find the value of 10^3.

$\qquad\qquad = 15,000$ Multiply.

2 **Evaluate $36 \div (1 + 2)^2$.**

$36 \div (1 + 2)^2 = 36 \div 3^2$ Add 1 and 2 inside the parentheses.

$\qquad\qquad = 36 \div 9$ Find the value of 3^2.

$\qquad\qquad = 4$ Divide.

Your Turn Evaluate each expression.

c. 3×10^4 **d.** $(5 - 1)^3 \div 4$

In addition to using the symbols $\times$ and $\cdot$, multiplication can be indicated by using parentheses.

$$2(3 + 5) \text{ means } 2 \times (3 + 5) \text{ or } 2 \cdot (3 + 5).$$
$$(4 - 2)3 \text{ means } (4 - 2) \times 3 \text{ or } (4 - 2) \cdot 3.$$

EXAMPLE **Evaluate an Expression**

3 **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.

EXAMPLE **Use an Expression to Solve a Problem**

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

Item	Quantity	Unit Cost
game station	1	$180.00
controller	3	$24.95
game	4	$35.99

$$\underbrace{\text{cost of game}}_{\$180} + \underbrace{\text{number of controllers}}_{3} \times \underbrace{\text{cost of controller}}_{\$24.95} + \underbrace{\text{number of games}}_{4} \times \underbrace{\text{cost of game}}_{\$35.99}$$

$= 180 + 74.85 + 143.96$ 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.

CONTENTS

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.

   Yutaka
   $16 - 24 \div 6 \cdot 2$
   $= 16 - 24 \div 12$
   $= 16 - 2 \text{ or } 14$

   Cynthia
   $16 - 24 \div 6 \cdot 2$
   $= 16 - 4 \cdot 2$
   $= 16 - 8 \text{ or } 8$

GUIDED PRACTICE

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. 4×10^2

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 $(6 + 8) \div (10 - 8)$.

Practice and Applications

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. $24 \div 3 + 5^3$

31. $7 + (8 - 7 + 2)^4$

32. $(2 + 10)^2 \div 4$

33. 6×10^2

34. 18×10^3

35. 1.95×10^2

36. 3.7×10^4

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. $9 \div 3 \cdot 14(10 - 8) - 60$

HOMEWORK HELP	
For Exercises	See Examples
15–28	1, 2
29–36, 43–45	3, 4
37–40, 46–48	5
41–42, 50	6
Extra Practice See pages 564, 596.	

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.

7 cm   7 cm

9.5 cm   9.5 cm

6 cm

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?

CONTENTS

Find the value of each expression.

43. 4.5×10^2

44. 3.08×10^4

45. 2.965×10^5

46. $3 \cdot 4(5 - 3.8) + 2.7$

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.

Item	Cost
ream of paper	$3.95
box of pens	$7.49
roll of tape	$1.29

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 $10 - 3 \cdot 2 + 4(15 - 5)$?

Ⓐ $10 - 3$ Ⓑ $3 \cdot 2$ Ⓒ $2 + 4$ Ⓓ $15 - 5$

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?

Ⓕ $3 \times 15 + 2 \times 24$ Ⓖ $5 \times (24 + 15)$

Ⓗ $2(24) + 3(15)$ Ⓘ $15 + 15 + 15 + 24 + 24$

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

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 K-2 — 39.4 days
Grades 3-5 — 44.1 days
Grades 6-8 — 30.2 days
Grades 9-12 — 19.3 days

Source: Market Data Retrieval and Education Market Research

By Cindy Hall and Bob Laird, USA TODAY
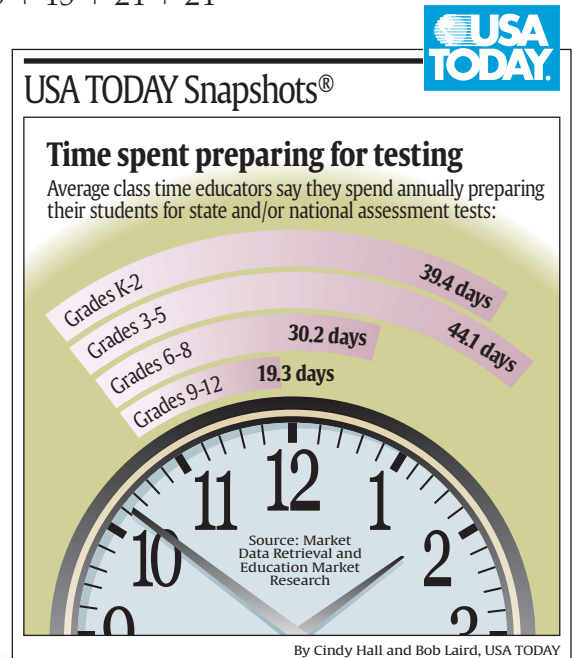
GETTING READY FOR THE NEXT LESSON

BASIC SKILL Divide.

66. $45 \div 15$

67. $90 \div 5$

68. $110 \div 10$

69. $52 \div 4$

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

Materials
• isometric dot paper

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.

Number of Triangles	1	2	3	4	5	6
Perimeter	3	4	5	?	?	?

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.

number of triangles

$n + 2$

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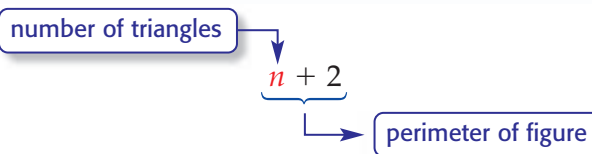
The expression $n + 2$ is called an **algebraic expression** because it contains variables, numbers, and at least one operation. The branch of mathematics that involves expressions with variables is called **algebra**.

EXAMPLE Evaluate an Expression

READING Math

Variables The letter x is often used as a variable. It is also common to use the first letter of a word as the variable. For example, use t for time or n for number.

1 Evaluate $n + 3$ if $n = 4$.

$n + 3 = 4 + 3$ Replace n with 4.
$\quad\quad = 7$

**Your Turn** Evaluate each expression if $c = 8$.

a. $c + 2$ b. $c - 3$ c. $15 - c$

CONTENTS

The following symbols are used for multiplication and division with variables. Note that the multiplication sign is usually omitted.

$6d$ means $6 \times d$ or $6 \cdot d$ | $9st$ means $9 \times s \times t$

ef means $e \times f$ | $\dfrac{c}{d}$ 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**.

8 is the coefficient of 8x. → $8x + y + 3$ ← constant

1 is the coefficient of y because $1y = y$.
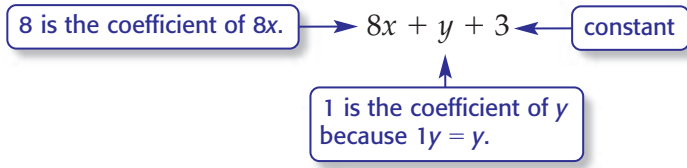
EXAMPLES **Evaluate Expressions**

1 **Evaluate $8w - 2v$ if $w = 5$ and $v = 3$.**

$8w - 2v = 8(5) - 2(3)$ Replace w with 5 and v with 3.

        $= 40 - 6$ Use the order of operations.

        $= 34$ Subtract 6 from 40.

2 **Evaluate $\dfrac{mn}{6}$ if $m = 8$ and $n = 12$.**

$\dfrac{mn}{6} = \dfrac{(8)(12)}{6}$ Replace m with 8 and n with 12.

    $= \dfrac{96}{6}$ The fraction bar is like a grouping symbol.

    $= 16$ Divide.

3 **Evaluate $y^2 + 2$ if $y = 3$.**

$y^2 + 2 = 3^2 + 2$ Replace y with 3.

      $= 9 + 2$ or 11   Use the order of operations.

Your Turn Evaluate each expression if $a = 4$ and $b = 3$.

d. $9a - 6b$ **e.** $\dfrac{ab}{2}$ **f.** $a^2 + 5$

EXAMPLE **Use an Expression to Solve a Problem**

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

$(220 - a) \times 0.6 = (220 - 17) \times 0.6$ Replace a with 17.

                 $= 203 \times 0.6$ or 121.8   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.

REAL-LIFE CAREERS

How Does an Athletic Trainer Use Math?

Athletic trainers use the formula $(220 - a) \times 0.6$, where a is a person's age, to find their minimum training heart rate.

Research

For information about a career as an athletic trainer, visit: msmath2.net/careers

CONTENTS

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.

$4x$	ab	$r \cdot 8$	$\dfrac{x}{y}$

GUIDED PRACTICE

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

4. $a + 7$ 5. $4b$ 6. $b + c$ 7. $6c - a$

8. $\dfrac{c}{4}$ 9. $\dfrac{5c + b}{5}$ 10. $4b^2$ 11. $\dfrac{3c^2}{a}$

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

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

Practice and Applications

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. $\dfrac{d}{5}$ 24. $\dfrac{16}{f}$ 25. $\dfrac{5d - 25}{5}$

26. e^2 27. $\dfrac{d^2}{2}$ 28. $6f^2$ 29. $11.9d - 10e$

30. $\dfrac{2f}{g^2}$ 31. $\dfrac{2.5f + 5}{3}$ 32. $7e^2 + 5$ 33. $\dfrac{(5 + g)^2}{2}$

HOMEWORK HELP

For Exercises	See Examples
14–19	1
20–22	2
23–25	3
26–35	4
38–40, 43–45	5

Extra Practice
See pages 565, 596.

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 $\left(\frac{q}{4}\right)$
4	1
6	1.5
8	?
10	?
12	?
14	?

42.

Dollars (d)	Quarters (4d)
1	4
2	8
3	?
4	?
5	?
6	?

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.

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.

44. Write an expression showing the cost of renting a boat for h hours.

45. How much would it cost if they rented the boat for 2, 3, or 4 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 $3y + 23$.

Boat Rentals
$45 per hour
with a
$65 nonrefundable deposit.

Spiral Review with Standardized Test Practice

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?
   Ⓐ $75b + 98g$ Ⓑ $b + g$ Ⓒ $75 + 98$ Ⓓ $75b \div 98g$

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. $9 + 9 \div 3$ 52. $4 \cdot 2(8 - 1)$ 53. $(17 + 3) \div 5$

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

GETTING READY FOR THE NEXT LESSON

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

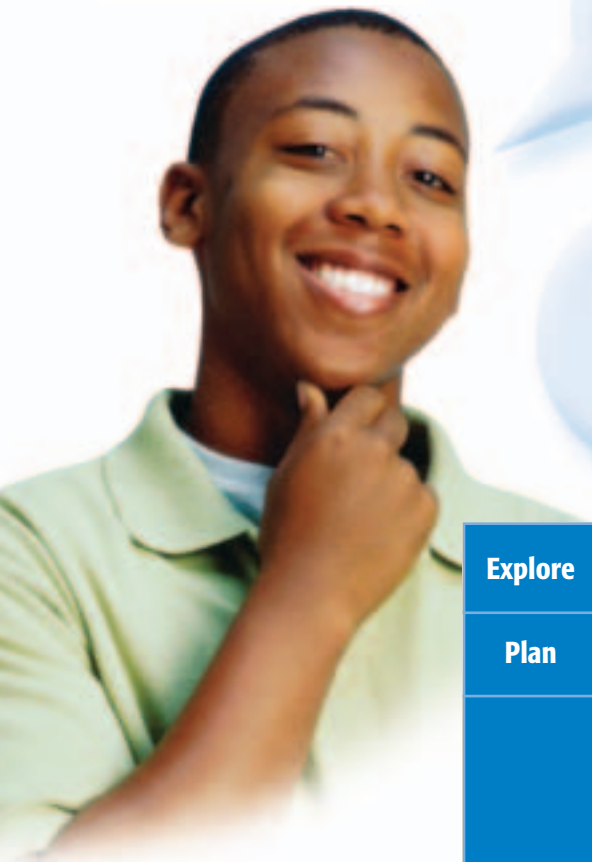55. $15 - 2(3) = 9$ 56. $20 \div 5 \times 4 = 1$ 57. $4^2 + 6 \cdot 7 = 154$ 58. $24 \div (7 - 3) = 6$

CONTENTS

Guess and Check

What You'll LEARN

Solve problems using the guess and check strategy.

> 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.

Explore	We know adult tickets are $7.50, student tickets are $4.00, and twice as many students bought tickets than did adults.
Plan	Let's make a guess and check if it is correct. Then adjust the guess until we get the correct answer.
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.

(l) PhotoDisc, (r)Richard Hutchings/Photo Researchers

◀ **CONTENTS** ▶

Solve. Use the guess and check strategy.

3. **CAR WASH** The band sponsored a car wash to help pay for uniforms. They charged $4 for a car and $6 for an SUV. During the first hour, they washed 16 vehicles and earned $78. How many of each type of vehicle did they wash?

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?

Mixed Problem Solving

Solve. Use any strategy.

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?

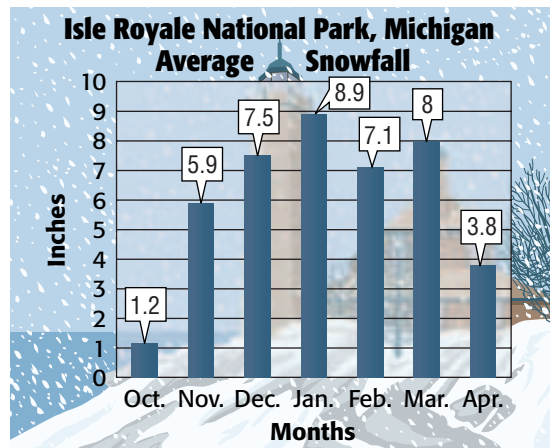| SONG	TIME
A	3 min 30 s
B	6 min 0 s
C	4 min 45 s
D	5 min 30 s
E	5 min 6 s
F	4 min 15 s
G	4 min 30 s
H	3 min 48 s

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.

Input	1	2	3	4	5	6	7
Output	1	8	27	?	?	?	?

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?

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.

Isle Royale National Park, Michigan Average Snowfall

Values by month: Oct. 1.2, Nov. 5.9, Dec. 7.5, Jan. 8.9, Feb. 7.1, Mar. 8, Apr. 3.8

Source: www.usatoday.com

11. What is the total average snowfall for October through April?

12. Between which two consecutive months is the difference in snowfall the least?

13. **STANDARDIZED TEST PRACTICE** Kelly has $2.80 in change in her purse. If the change is made up of an equal number of nickels, dimes, and quarters, how many of each does she have?

Ⓐ 4   Ⓑ 5   Ⓒ 6   Ⓓ 7

CONTENTS

Algebra: Equations

What You'll LEARN

Solve equations using mental math.

NEW Vocabulary

equation
solution
solving an equation
defining the variable

MATH Symbols

=   is equal to
≠   is not equal to

WHEN am I ever going to use this?

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.

Women's National Basketball Association, 2003

Team	Wins	Losses
Detroit	25	?
Los Angeles	24	?
Houston	20	?
Charlotte	18	?
New York	16	?
Phoenix	8	?

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.

$$4 + 3 = 8 - 1 \qquad\qquad 3(4) = 24 \div 2 \qquad\qquad 17 = 13 + 2 + 2$$

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**

Solve $18 = 14 + t$ mentally.

$18 = 14 + t$ Write the equation.

$18 = 14 + 4$ You know that 14 + 4 is 18.

$18 = 18$ Simplify.

The solution is 4.

Your Turn Solve each equation mentally.
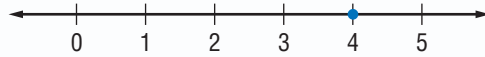
a. $p - 5 = 20$ b. $8 = y \div 3$ c. $7h = 56$

CONTENTS

Graph the Solution of an Equation

① **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, 4.

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**.

EXAMPLE **Write an Equation to Solve a Problem**

② **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?

Words	The cost of a hamburger, fries, and soft drink is $5.50.
Variable	Let h represent the cost of the hamburger.
Equation	$h + 2.50 = 5.50$

$h + 2.50 = 5.50$ 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.

EXAMPLE **Find a Solution of an Equation**

③ **MULTIPLE-CHOICE TEST ITEM**

What value of x is a solution of $x + 14.6 = 30.2$?

Ⓐ 14.9　　　Ⓑ 15.2　　　Ⓒ 15.6　　　Ⓓ 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.
$x + 14.6 = 30.2$	$x + 14.6 = 30.2$	$x + 14.6 = 30.2$
$14.9 + 14.6 \stackrel{?}{=} 30.2$	$15.2 + 14.6 \stackrel{?}{=} 30.2$	$15.6 + 14.6 \stackrel{?}{=} 30.2$
$29.5 \neq 30.2$ 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.

STUDY TIP

Defining the Variable Use the first letter of the word you are defining as a variable. For example: h stands for the cost of a hamburger.

Test-Taking Tip

Solutions
Since an equation with one variable has only one solution, the value of 16.1, or choice D, does not need to be checked.

Skill and Concept Check

1. **Writing Math** 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.

> Joshua
> $w = 25$

> Ivan
> $W = 75$

GUIDED PRACTICE

Solve each equation mentally.

4. $y - 18 = 20$ 5. $5 + a = 22$ 6. $w \div 4 = 7$

7. $\dfrac{r}{9} = 6$ 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?

Practice and Applications

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. $n = \dfrac{30}{6}$ 22. $b - 42 = 84$

23. $7t = 77$ 24. $3d = 99$ 25. $22 + h = 42$

26. $20 = y \div 5$ 27. $16 = \dfrac{u}{4}$ 28. $\dfrac{z}{7} = 12$

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.

Type of Penguin	Height (in.)
Emperor	51
Adelie	18

Data Update How do the heights of other types of penguins compare to Adelie penguins? Visit **msmath2.net/data_update** to learn more.

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.

Spiral Review with Standardized Test Practice

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

   Ⓐ 2   Ⓑ 4   Ⓒ 6   Ⓓ 8

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

From	To	Distance (air mi)
Memphis, TN	New Orleans, LA	358
Phoenix, AZ	New Orleans, LA	1,316

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)

GETTING READY FOR THE NEXT LESSON

BASIC SKILL Multiply.

55. $2 \cdot (4 + 10)$ **56.** $(9 \cdot 1) \cdot 8$ **57.** $(5 \cdot 3)(5 \cdot 2)$ **58.** $(6 + 8) \cdot 12$

Tim Davis/Photo Researchers

CONTENTS

Vocabulary and Concepts

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)

Skills and Applications

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. $(2^3 + 4) + 3^2$

10. $\dfrac{2(7 - 3)}{2^2}$

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

11. $x - 5$

12. $3y + 10z$

13. $\dfrac{yz}{2}$

14. $\dfrac{(y + 8)^2}{x}$

Solve each equation mentally. (Lesson 1-5)

15. $x + 16 = 23$

16. $36 = 3y$

17. $\dfrac{65}{z} = 5$

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

5.4 ft

2.3 ft
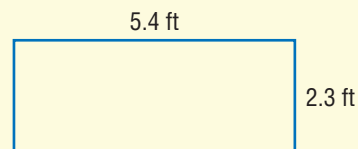
Standardized Test Practice

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)

   (A) 20 days   (B) 21 days

   (C) 22 days   (D) 23 days

20. **GRID IN** The expression $\dfrac{w}{30}$, 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)

CONTENTS

The Game Zone

A Place To Practice Your Math Skills
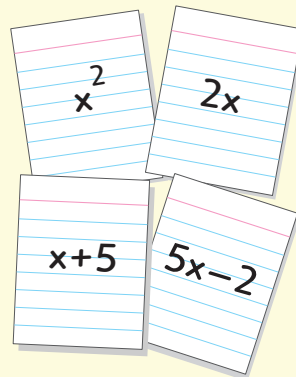
Express Yourself!

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.

x^2 $2x$

$x+5$ $5x-2$

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.

CONTENTS

Algebra: Properties

What You'll LEARN

Use addition and multiplication properties to solve problems.
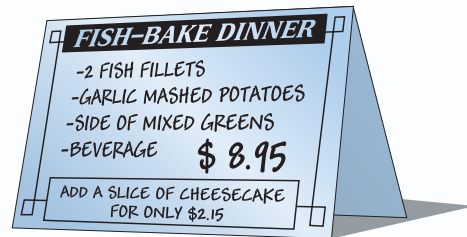
NEW Vocabulary

equivalent expressions
properties

Link to READING

Everyday Meaning of Distribute: to divide among several, as in distribute a deck of cards
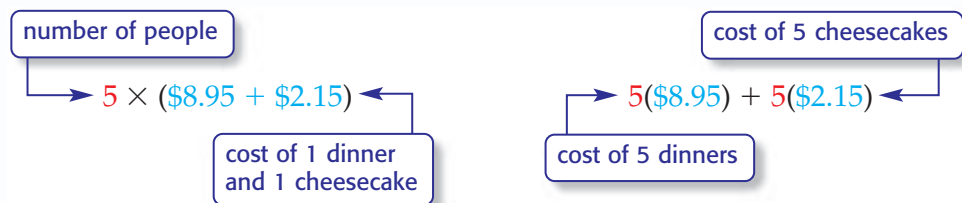
WHEN **am I ever going to use this?**

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

FISH–BAKE DINNER
-2 FISH FILLETS
-GARLIC MASHED POTATOES
-SIDE OF MIXED GREENS
-BEVERAGE **$ 8.95**
ADD A SLICE OF CHEESECAKE
FOR ONLY $2.15

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:

number of people

$5 \times (\$8.95 + \$2.15)$

cost of 1 dinner and 1 cheesecake

cost of 5 cheesecakes

$5(\$8.95) + 5(\$2.15)$

cost of 5 dinners

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.

Noteables   **Key Concept: Distributive Property**

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

Symbols   **Arithmetic**   **Algebra**
$$3(4 + 6) = 3(4) + 3(6) \qquad a(b + c) = a(b) + a(c)$$

EXAMPLES **Use the Distributive Property**

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

1 **5(3 + 2)**

$5(3 + 2) = 5 \cdot 3 + 5 \cdot 2$
$= 15 + 10$ Multiply.
$= 25$ Add.

2 **(7 + 4)3**

$(7 + 4)3 = 7 \cdot 3 + 4 \cdot 3$
$= 21 + 12$ Multiply.
$= 33$ Add.

CONTENTS

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 8×250. You can use the Distributive Property to multiply mentally.

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

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.

STUDY TIP

Properties The *Commutative Property* shows how the terms move and change places.

The *Associative Property* shows how the parentheses move and change places.

Noteables

Key Concept: Properties

Commutative Property	The order in which two numbers are added or multiplied does not change their sum or product.
Associative Property	The way in which three numbers are grouped when they are added or multiplied does not change their sum or product.
Identity Property	The sum of an addend and 0 is the addend. The product of a factor and 1 is the factor.

EXAMPLES **Identify Properties**

Name the property shown by each statement.

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

$15 \times 10 = 10 \times 15$ Commutative Property of Multiplication

$4 \times 1 = 4$ Identity Property of Multiplication

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

Your Turn Name the property shown by each statement.

a. $1 \times (3 \times 4) = (1 \times 3) \times 4$ **b.** $a + 0 = a$

Brian A. Vikander/CORBIS

CONTENTS

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.

HOMEWORK HELP

For Exercises	See Examples
11–16	1, 2
39, 40	3
19–30	4, 5, 6, 7

Extra Practice
See pages 565, 596.

From	To	Driving Distance (mi)
Jacksonville, FL	Charleston, SC	239
Charleston, SC	Norfolk, VA	531

CONTENTS

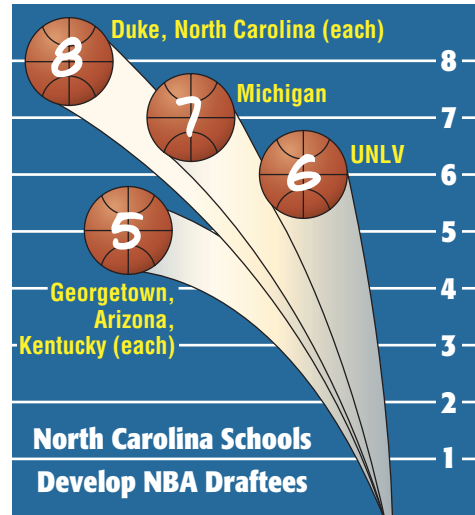**Use properties to rewrite each expression as an equivalent expression without parentheses.**

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.*

Duke, North Carolina (each) — 8

Michigan — 7

UNLV — 6

5

Georgetown, Arizona, Kentucky (each)

8 7 6 5 4 3 2 1

North Carolina Schools Develop NBA Draftees

Source: nbcsports.com

Spiral Review with Standardized Test Practice

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** $(p + q) + r$
- **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, ?

CONTENTS

Sequences

What You'll LEARN

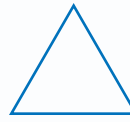Recognize and extend patterns for sequences.

NEW Vocabulary

sequence
term
arithmetic sequence
geometric sequence

Link to READING

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

HANDS-ON Mini Lab

Materials
• straightedge

Work with a partner.

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

3 sides
0 diagonals

4 sides
2 diagonals

5 sides
5 diagonals

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**.

8, 11, 14, 17, 20, …
+3 +3 +3 +3

In an **arithmetic sequence**, each term is found by *adding* the same number to the previous term.

3, 6, 12, 24, 48, …
×2 ×2 ×2 ×2

In a **geometric sequence**, each term is found by *multiplying* the previous term by the same number.

EXAMPLES **Describe Patterns in Sequences**

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

1 **8, 13, 18, 23, …**

8, 13, 18, 23, …
+5 +5 +5

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

2 **1, 4, 16, 64, …**

1, 4, 16, 64, …
×4 ×4 ×4

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

Your Turn 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, …

CONTENTS

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, …**

0, 13, 26, 39, … Each term is 13 greater
 $+13$ $+13$ $+13$ than the previous term.

Continue the pattern to find the next three terms.

$39 + 13 = 52$ $52 + 13 = 65$ $65 + 13 = 78$

The next three terms are 52, 65, and 78.

2 **0.16, 0.8, 4, 20, 100, …**

0.16, 0.8, 4, 20, … Each term is 5 times the previous term.
 $\times 5$ $\times 5$ $\times 5$

Continue the pattern to find the next three terms.

$20 \times 5 = 100$ $100 \times 5 = 500$ $500 \times 5 = 2{,}500$

The next three terms are 100, 500, and 2,500.

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.

GUIDED PRACTICE

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.

CONTENTS

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.

1   3   6   10   15
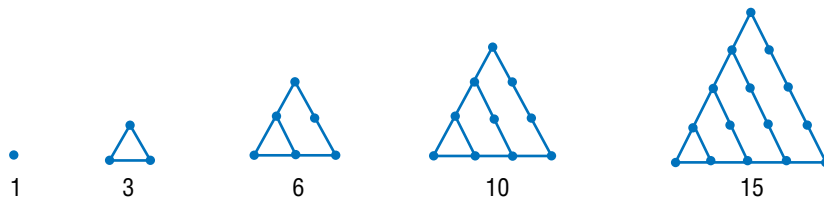
25. Write a sequence formed by the first eight triangular numbers.

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, … .

Spiral Review with Standardized Test Practice

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?

Time (h)	Height (in.)
0	5
1	27
2	49
3	71

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)

GETTING READY FOR THE NEXT LESSON

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

33. 52×10

34. $400 \div 1,000$

35. $32 \div 10$

36. 0.31×100

msmath2.net/self_check_quiz

Exploring Sequences

What You'll LEARN

Explore patterns in sequences using paper folding.

Materials

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

INVESTIGATE *Work with a partner.*

STEP 1 Fold a piece of paper in half. Make a table like the one at the right and record the number of layers of paper.

Number of Folds	Layers of Paper	Fraction of Paper *Not* Shaded
1	2	$\frac{1}{2}$
2	4	$\frac{1}{4}$
3	8	
4		
⋮		

STEP 2 Shade one side of the folded paper.

STEP 3 Open the piece of paper. Record the fractional part of the paper that is *not* shaded. Refold the paper.

STEP 4 Fold your paper in half again so that the unshaded side is on the outside. Record the number of layers of paper.

STEP 5 Shade one side of the folded paper.

STEP 6 Open the piece of paper. Record the fractional part of the paper that is *not* shaded. Completely refold the paper.

STEP 7 Continue this folding, shading, and recording process for five folds.

Writing Math

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.

CONTENTS

Measurement: The Metric System

HANDS-ON Mini Lab

Work with a partner.

The widths of two objects are shown below.

Object	Width (millimeters)	Width (centimeters)
computer diskette	?	8.9
CD case	?	14.4

**Materials**
- centimeter ruler
- computer diskette
- CD case
- meterstick

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.

Prefix	Meaning in Words	Meaning in Numbers
kilo-	thousands	1,000
centi-	hundredths	0.01
milli-	thousandths	0.001

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

MULTIPLY to convert from larger units to smaller units.

$\times 1,000$ $\times 100$ $\times 10$

kilometer km → meter m → centimeter cm → millimeter mm
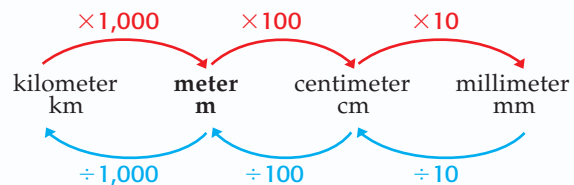
DIVIDE to convert from smaller units to larger units.

$\div 1,000$ $\div 100$ $\div 10$

EXAMPLES Convert Units of Length

Complete.

1 4.5 m = __?__ cm

To convert from meters to centimeters, multiply by 100.
$4.5 \times 100 = 450$
4.5 m = 450 cm

2 2,600 m = __?__ km

To convert from meters to kilometers, divide by 1,000.
$2,600 \div 1,000 = 2.6$
2,600 m = 2.6 km

CONTENTS

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.

EXAMPLES   Convert Units of Mass

Complete.

1 8.43 kg = __?__ g

To convert from kilograms to grams, multiply by 1,000.
$8.43 \times 1{,}000 = 8{,}430$
8.43 kg = 8,430 g

2 500 mg = __?__ g

To convert from milligrams to grams, divide by 1,000.
$500 \div 1{,}000 = 0.5$
500 mg = 0.5 g

Your Turn Complete.

a. 23.5 g = __?__ mg

b. 9,014 g = __?__ kg

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.

EXAMPLES   Convert Units of Capacity

Complete.

3 3.2 L = __?__ mL

To convert from liters to milliliters, multiply by 1,000.
$3.2 \times 1{,}000 = 3{,}200$
3.2 L = 3,200 mL

4 1,640 L = __?__ kL

To convert from liters to kiloliters, divide by 1,000.
$1{,}640 \div 1{,}000 = 1.64$
1,640 L = 1.64 kL

Your Turn Complete.

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.

Concept Summary   **Converting Units**

	Larger Units → Smaller Units (multiply by a power of 10)	Smaller Units → Larger Units (divide by a power of 10)
Units of Length	1 km = 1,000 m 1 m = 100 cm 1 cm = 10 mm	1 mm = 0.1 cm 1 cm = 0.01 m 1 m = 0.001 km
Units of Mass	1 kg = 1,000 g 1 g = 1,000 mg	1 mg = 0.001 g 1 g = 0.001 kg
Units of Capacity	1 kL = 1,000 L 1 L = 1,000 mL	1 mL = 0.001 L 1 L = 0.001 kL

Aaron Haupt

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

GUIDED PRACTICE

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.

169 m

Complete.

34. 0.05 km = __?__ mm   35. 0.93 km = __?__ cm
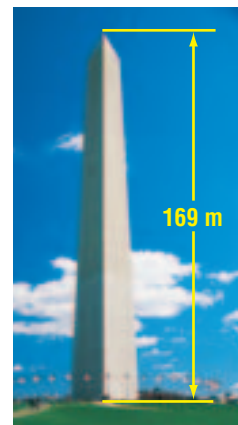
36. 23,000 mg = __?__ kg   37. 40,000 mL = __?__ kL

38. TRACK AND FIELD Refer to the table. Convert the distance of each event to kilometers.

Event	Number of Kilometers
10,000-meter run	?
110-meter hurdles	?
1,600-meter relay	?
3,000-meter steeplechase	?

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 cobblers for the fair. The recipe requires 900 grams of peaches per cobbler. If Evan has 4.5 kilograms of peaches, how many cobblers 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?

Spiral Review with Standardized Test Practice

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

Ⓐ 4.5 mg   Ⓑ 4.5 g   Ⓒ 45 g   Ⓓ 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.** $(6 - 5)10$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Multiply. (Lesson 1-3)

55. $8 \cdot 10^2$ **56.** $5 \cdot 10^3$ **57.** $4 \cdot 10^5$

58. $2.7 \cdot 10^3$ **59.** $65 \cdot 10^2$ **60.** $1.35 \cdot 10^4$

Study Skill

Use Power Notes

Do you ever have trouble organizing your notes? Try using power notes. They can help you organize the main ideas and details in a lesson.

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.

$$\times 1,000 \qquad \times 100 \qquad \times 10$$

km   m   cm   mm

$$\div 1,000 \qquad \div 100 \qquad \div 10$$

```
   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

What You'll LEARN

Write numbers greater than 100 in scientific notation and in standard form.

NEW Vocabulary

scientific notation

REVIEW Vocabulary

standard form: numbers written without exponents (Lesson 1-2)

WHEN 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.

	Standard Form	Abbreviated Form
Number of Parking Spaces	?	13 thousand
Area of Mall (square feet)	4,200,000	?

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.

$$4.2 \text{ million} = 4.2 \times 1,000,000$$
$$= 4.2 \times 10^6 \qquad 10^6 = 1,000,000$$

Noteables   Key Concept: Scientific Notation

Words   A number is expressed in scientific notation when it is written as the product of a number and a power of ten. The number must be greater than or equal to 1 and less than 10.

Examples $60,000 = 6.0 \times 10^4$ $3.5 \text{ billion} = 3.5 \times 10^9$

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

EXAMPLE   Write a Number in Standard Form

1 Write 5.2×10^5 in standard form.

$$5.2 \times 10^5 = 5.2 \times 100,000 \quad 10^5 = 100,000$$
$$= 520000 \qquad \text{Move the decimal point 5 places to the right.}$$
$$= 520,000$$

Your Turn   Write each number in standard form.

a. 7.2×10^4 **b.** 3.8×10^9 **c.** 1.0×10^8

Owen Franken/Stock Boston

CONTENTS

To write a number in scientific notation, move the decimal to the right of the first nonzero number. Then find the power of ten.

$$13,000 = 1.3 \times 10^4$$

Move the decimal point to the right of the first nonzero digit.

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.

$$= 2.35 \times 10^7$$

Your Turn Write each number in scientific notation.

d. 38,000,000   **e.** 19,000   **f.** 86.1 billion

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

EXAMPLE **Compute with Large Numbers**

2 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 billion = 5,700,000,000

Enter 5700000000 [×] 6 [ENTER =].

The number **3.42**$_{\times 10^{10}}$ on the calculator represents 3.42×10^{10}.

So, Lake Mead has about 3.42×10^{10} cubic meters of water.

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, 3.0×10^6 or 3.0×10^3? Explain your reasoning.

GUIDED PRACTICE

Write each number in standard form.

4. 5.1×10^4 **5.** 1.0×10^5 **6.** 8.05×10^6

Write each number in scientific notation.

7. 70,000   **8.** 510,000   **9.** 17,500,000

CONTENTS

Practice and Applications

Write each number in standard form.

10. 4.2×10^3 **11.** 7.3×10^4 **12.** 6.9×10^6 **13.** 3.38×10^5

14. 1.1×10^8 **15.** 8.98×10^6 **16.** 5.16×10^4 **17.** 7.98×10^5

18. 1.05×10^7 **19.** 9.90×10^8 **20.** 5.33×10^{10} **21.** 8.06×10^7

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

23. Order the numbers 53,400, 4.98×10^6, 5.03×10^5, 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 5.43×10^{16}.

Power of 10	Name
10^6	million
10^9	billion
10^{12}	trillion
10^{15}	quadrillion
10^{18}	quintillion

Replace each ● **with** <, >, **or** = **to make a true sentence.**

38. 5,000 ● 5.0×10^3 **39.** 600 ● 6.0×10^1

40. 81,900 ● 8.19×10^5 **41.** 1 million ● 1.1×10^6

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

←1.55×10^8 km→
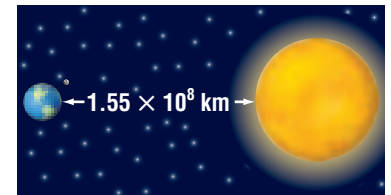
Spiral Review with Standardized Test Practice

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

Ⓐ 4.4579×10^6 Ⓑ 4.4579×10^7 Ⓒ 4.4579×10^8 Ⓓ 4.4579×10^9

46. SHORT RESPONSE Write the standard form of 5.56×10^{12}.

Complete. (Lesson 1-8)

47. 1.01 kg = __?__ g **48.** 36 mL = __?__ L **49.** 2.33 km = __?__ 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? (Lesson 1-7)

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Vocabulary and Concept Check

algebra (p. 18)
algebraic expression (p. 18)
arithmetic sequence (p. 34)
base (p. 10)
coefficient (p. 19)
constant (p. 19)
cubed (p. 10)
defining the variable (p. 25)
equation (p. 24)
equivalent expressions (p. 30)
evaluate (p. 11)

exponent (p. 10)
exponential form (p. 11)
factors (p. 10)
geometric sequence (p. 34)
gram (p. 39)
kilogram (p. 39)
liter (p. 39)
meter (p. 38)
metric system (p. 38)
numerical expression (p. 14)
order of operations (p. 14)

powers (p. 10)
properties (p. 31)
scientific notation (p. 43)
sequence (p. 34)
solution (p. 24)
solving an equation (p. 24)
squared (p. 10)
standard form (p. 11)
term (pp. 19, 34)
variable (p. 18)

Choose the letter of the term that best matches each phrase.

1. a number that makes an equation true

2. numbers expressed using exponents

3. two or more numbers that are multiplied together to form a product

4. rules used to ensure that numerical expressions have only one value

5. tells how many times the base is used as a factor

a. algebra
b. solution
c. order of operations
d. factors
e. powers
f. exponent

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?

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.

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 $25 \cdot 7 = 175$
Taylor's garden is 175 square feet.

Examine Add 25 seven times.

msmath2.net/vocabulary_review

CONTENTS

1-2 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.

$4^5 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$

$\quad = 1{,}024$

1-3 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. 12×10^4

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.

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

$\qquad\qquad = 8$ Subtract.

1-4 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. $\dfrac{(b + c)^2}{3}$

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.

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

$\qquad\quad = 32 - 15$ Multiply.

$\qquad\quad = 17$ Subtract.

1-5 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. $\dfrac{t}{9} = 12$

38. $100 = 20g$ 39. $p - 49 = 18$

Example 5 Solve $14 = 5 + x$ mentally.

$14 = 5 + x$ 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. $29 \cdot 1 = 29$

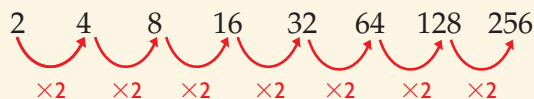**Example 6** Name the property shown by the statement $12 + (8 + 2) = (12 + 8) + 2$.

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.

$$2 \quad 4 \quad 8 \quad 16 \quad 32 \quad 64 \quad 128 \quad 256$$
$$\times 2 \quad \times 2 \quad \times 2 \quad \times 2 \quad \times 2 \quad \times 2 \quad \times 2$$

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

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

Complete.

48. $3.6 \text{ km} = \underline{\quad ? \quad} \text{ m}$

49. $29 \text{ L} = \underline{\quad ? \quad} \text{ mL}$

50. $237 \text{ mg} = \underline{\quad ? \quad} \text{ g}$

51. $7 \text{ mL} = \underline{\quad ? \quad} \text{ L}$

52. $3,200 \text{ cm} = \underline{\quad ? \quad} \text{ m}$

Example 8 Complete.

$6,750 \text{ m} = \underline{\quad ? \quad} \text{ km}$

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.

$$23,100,000 = 2.31 \times 10^7$$

CONTENTS

Vocabulary and Concepts

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.

Skills 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. $\dfrac{xz}{y + 13}$

Solve each equation mentally.

11. $9 + m = 16$

12. $d - 14 = 37$

13. $23 = \dfrac{92}{t}$

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 m = ___?___ cm

18. 27 mL = ___?___ L

19. $8,200$ g = ___?___ kg

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

Container	Capacity
#1	5400 mL
#2	0.008 kL
#3	4.78 L

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.

Write each number in scientific notation.

22. 42,300

23. 3,780,000

24. 502,000,000

Standardized Test Practice

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?

  Ⓐ $125 + 2n$ Ⓑ $125n + 2 Ⓒ $125n + 2n$ Ⓓ $127
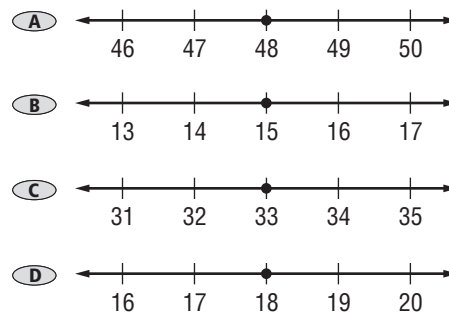
PART 1 Multiple Choice

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

1. The strategy of guess and check would be *most* useful in solving which problem? (Lesson 1-1)

    Ⓐ About how long does it take to travel 62 miles at 58 miles per hour?

    Ⓑ What is the area of a rectangle if it has a length of 4.5 centimeters and a width of 9 centimeters?

    Ⓒ 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?

    Ⓓ 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)

    Ⓕ $(36 \times 8) + 25$

    Ⓖ $(36 + 25) \times 8$

    Ⓗ $(8 \times 25) + 36$

    Ⓘ $(36 \div 8) + 25$

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)

    Ⓐ $5 \div s$

    Ⓑ $s - 5$

    Ⓒ $5s$

    Ⓓ $s \div 5$

4. Which value of p makes $64 \div p = 8$ a true sentence? (Lesson 1-5)

    Ⓕ 2

    Ⓖ 2^2

    Ⓗ 2^3

    Ⓘ 3^2

5. Which is the graph of the solution of $x - 15 = 33$? (Lesson 1-5)

    Ⓐ
    ```
    ──┼────┼────●────┼────┼──
     46   47   48   49   50
    ```

    Ⓑ
    ```
    ──┼────┼────●────┼────┼──
     13   14   15   16   17
    ```

    Ⓒ
    ```
    ──┼────┼────●────┼────┼──
     31   32   33   34   35
    ```

    Ⓓ
    ```
    ──┼────┼────●────┼────┼──
     16   17   18   19   20
    ```

6. Identify the property shown by the sentence $16 + (4 + 7) = (16 + 4) + 7$. (Lesson 1-6)

    Ⓕ Commutative Property of Addition

    Ⓖ Associative Property of Addition

    Ⓗ Associative Property of Multiplication

    Ⓘ Identity Property of Multiplication

7. Which is the next term of the sequence 6, 12, 18, 24, … ? (Lesson 1-7)

    Ⓐ 28   Ⓑ 30

    Ⓒ 36   Ⓓ 48

8. Every morning, Morgan swims 0.5 kilometer. How many meters does she swim? (Lesson 1-8)

    Ⓕ 5 m   Ⓖ 50 m

    Ⓗ 100 m   Ⓘ 500 m

9. Which is 5,300,000 written in scientific notation? (Lesson 1-9)

    Ⓐ 0.53×10^6 Ⓑ 53×10^5

    Ⓒ 5.3×10^6 Ⓓ 5.3×10^7

CONTENTS

PART 2 Short Response/Grid In

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)

World Series Championships (selected teams, 1903–2003)
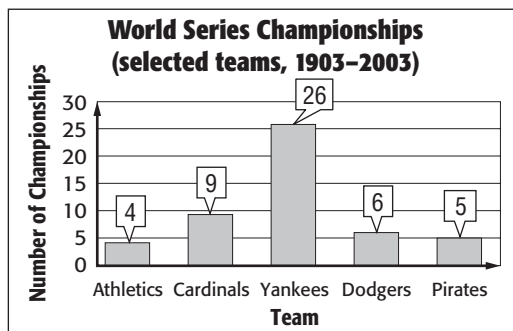
Source: *The World Almanac*

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)

TEST-TAKING TIP

Question 13 Fill in the answer bubbles below each numeral completely on the answer grid-in sheet. That way your answer will be clear.

16. Four countries and their approximate populations in 2001 are shown in the table. Which country has the least population? (Lesson 1-9)
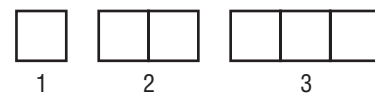
Country	Population, 2003
Honduras	6.7×10^6
Australia	2.0×10^7
Croatia	4.3×10^6
Denmark	5.4×10^6

Source: www.factmonster.com

PART 3 Extended Response

Record your answers on a sheet of paper. Show your work.

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*.

Figure	Perimeter
1	8
2	12
3	?
4	?
5	?
6	?
7	?
8	?

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?

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?