# **Unit 1** Number, Operations, and Statistics

## Focus

Write, interpret, and use mathematical expressions and equations.

#### Chapter 1 Algebra: Number Patterns and Functions

**BIGIDEE** Write mathematical expressions and equations.

**BIG Idea**) Use variables to represent numbers.

## Chapter 2 Statistics and Graphs

20

**BIG Idea** Construct and analyze statistical representations of data.

## Problem Solving in Health

## Real-World Unit Project

and the second

**Fun to Be Fit!** Think of all the different ways there are to exercise and keep fit. You could play a sport, join a gym, take an aerobics or dance class, or even just go for a run around your neighborhood. How do these activities compare with one another? How many Calories does each activity burn per hour? How do the costs of the activities compare with one another? Well, put on your running shoes because you will research the answers to these and other related questions. You'll gather data about many exercise methods and create statistical displays to compare them. Are you ready to exercise your mind?

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## Indiana Academic Standards

**6.2.3** Apply the correct order of operations and the properties of real numbers [identity, inverse, commutative, associative and distributive properties] to evaluate numerical expressions, including those that use grouping symbols such as parentheses. Justify each step in the process. **P.1.1** Build new mathematical knowledge through problem solving.

HAPTE

**Key Vocabulary** 

evaluate (p. 42) function (p. 49) variable (p. 42)

## Real-World Link

**Stadiums** Ohio Stadium, home of The Ohio State University Buckeyes, has a seating capacity of 101,568. You can use the equation x + 35,358 = 101,568to find the value of *x*, the seating capacity of Ohio Stadium on opening day in 1922.

## OLDABLES

## **Study Organizer**

**1** Stack the pages, placing the sheets of paper  $\frac{3}{4}$  inch apart.

Crease and staple along the fold.



with five sheets of notebook paper.

2 Roll up bottom edges. All tabs should be the same size.

4 Label the tabs with the

topics from the chapter.

Algebra: Number Patterns and Functions Make this Foldable to help you organize your notes. Begin





Algebra: Number Patterns and Functions

# **GET READY for Chapter 1**

**Diagnose Readiness** You have two options for checking Prerequisite Skills.

# Option 2

**IN Math Online** Take the Online Readiness Quiz at glencoe.com.

Take the Quick Quiz below. Refer to the Quick Review for help.

**Option 1** 

QUICK Quiz	QUICK Review
Add. (Prior Grade)         1. 83 + 129       2. 99 + 56         3. 67 + 42       4. 79 + 88         5. 78 + 97       6. 86 + 66	<ul> <li>Example 1 Find 359 + 88.</li> <li>Line up the digits at the ones place.</li> <li>11 Add the ones. Put the 7 in the ones place and place the 1 above the tens place.</li> <li>+ 88 447 Add the tens. Put the 4 in the tens place and place the 1 above the hundreds place. Then add the hundreds.</li> </ul>
Subtract. (Prior Grade)         7. 43 − 7       8. 75 − 27         9. 128 − 34       10. 150 − 68         11. 102 − 76       12. 235 − 126         13. MONEY Ariana bought three shirts for a total of \$89. If one shirt costs \$24 and another costs \$31, how much did the third shirt cost?	<b>Example 2</b> Find 853 – 79. Line up the digits at the ones place. 71413 Since 9 is larger than 3, rename 3 as 13. \$53 Rename the 5 in the tens place as 14 - 79 - 774 and the 8 in the hundreds place as 7. Then subtract.
Multiply. (Prior Grade)14. $25 \times 12$ 15. $18 \times 30$ 16. $42 \times 15$ 17. $27 \times 34$ 18. $50 \times 16$ 19. $47 \times 22$	Example 3 Find 15 × 23. 15 × 23 45 Multiply. 15 × 3 = 45 + 300 345 Add. 45 + 300 = 345
Divide. (Prior Grade)20. $72 \div 9$ 21. $84 \div 6$ 22. $126 \div 3$ 23. $146 \div 2$ 24. $208 \div 4$ 25. $504 \div 8$	Example 4 Find 318 ÷ 6. $6)\overline{318}$ Divide in each place-value position from -30 left to right. -18 Since 18 – 18 = 0, 0 there is no remainder.

# **A Plan for Problem Solving**

## **MAIN IDEA**

Solve problems using the four-step plan.

#### **IN Academic Standards**

P.1.1 Build new mathematical knowledge through problem solving.

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- Extra Examples
- Personal Tutor
- Self-Check Quiz

Reasonableness In the last

step of this plan, you check

the reasonableness of the answer by comparing it to

the estimate.

## GET READY for the Lesson

**CRAFTS** Michelle is making 8 necklaces by stringing beads together. To make one necklace, she will repeat the pattern of beads shown four times.



- 1. How many purple and yellow beads are used to make one necklace?
- 2. How many purple and yellow beads will be needed to make all eight necklaces?
- **3**. Explain how you found the number of each color of beads needed to make all eight necklaces.

When solving math problems, it is often helpful to have an organized problem-solving plan. The four steps below can be used to solve any problem.

- **Understand** Read the problem carefully.
  - What facts do you know?
  - What do you need to find out?
  - Is enough information given?
  - Is there extra information?
  - How do the facts relate to each other?
    - Plan a strategy for solving the problem.
  - Estimate the answer.
  - Use your plan to solve the problem.
  - If your plan does not work, revise it or make a new plan.
  - What is the solution?
  - Reread the problem.
  - Does the answer fit the facts given in the problem?
  - Is the answer close to your estimate?
  - Does the answer make sense?
  - If not, solve the problem another way.

Solve

Check





## Real-World Link ...

Annika Sorenstam was the first female golfer to surpass the \$20 million mark for career earnings. Source: LPGA Some problems can be easily solved by adding, subtracting, multiplying, or dividing. Key words and phrases play an important role in deciding which operation to use.

Addition	Subtraction	Multiplication	Division
plus	minus	times	divided by
sum	difference	product	quotient
total	less	multiplied by	
in all	subtract	of	

## EXAMPLE Use the Problem-Solving Plan

GOLF Refer to the graph below. How many more official career wins did Kathy Whitworth have than Nancy Lopez?

Official Career Wins of	on the LPGA Tour*
Golfer	Number of Wins
Kathy Whitworth	88
Annika Sorenstam	69 🗾
Louise Suggs	58
Nancy Lopez	48
Sandra Haynie	42
Karrie Webb	35
MAXAN AVALANO	
	NVAVA VALVA VALVA
Source:   PGA	* As of 2006 season

Understand Extra information is given in the graph. You know the number of career wins made by many golfers. You need to find how many more wins Kathy Whitworth had than Nancy Lopez.Plan To find the difference, subtract 48 from 88. Since the time by formation of the statement o

question asks for an exact answer, use mental math or paper and pencil. Before you calculate, estimate.

**Estimate** 90 - 50 = 40

88 - 48 = 40

Kathy Whitworth had 40 more career wins than Nancy Lopez.

Compared to the estimate, the answer is reasonable. Since 40 + 48 is 88, the answer is correct.

## CHECK Your Progress

Solve

Check

a. **GOLF** Refer to the graph above. The number of tournaments Annika Sorenstam participated in is about 4 times the number of tournaments she actually won. About how many tournaments did Annika participate in?



## Real-World EXAMPLE

**2 ALLOWANCE** The table shows how Kaylee's weekly allowance increases based on her age. If the pattern continues, how much allowance will Kaylee receive when she is 13 years old?

Age	9	10	11	12	13
Weekly Allowance	\$3.25	\$4.00	\$4.75	\$5.50	

**Understand** You know Kaylee's weekly allowance by age. You need to find her weekly allowance at age 13.

Since an exact answer is needed and the question contains a pattern, use mental math.

## Solve

Plan

\$3.25 \$4.00 \$4.75 \$5.50 ? +\$0.75 +\$0.75 +\$0.75 The values increase by \$0.75 each time. ]

The values increase by 0.75 each time. The next value should increase by 0.75. So, when Kaylee is 13 years old, her allowance will be 5.50 + 0.75, or 6.25.

**Check** Start with \$6.25 and subtract \$0.75. Continue subtracting to see if she would earn \$3.25 when she is 9 years old. Since she does earn \$3.25 at 9 years old, the answer is correct.

## **CHECK** Your Progress

**b. TRACK** Julian is on the track team. The table shows the number of sprints he runs in the first four days of practice. If the pattern continues, how many sprints will he run on Friday?

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Sprints	2	4	7	11	

## CHECK Your Understanding

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## For Exercises 1 and 2, use the four-step plan to solve each problem.

- Example 1 (p. 25)
- 1. **BEARS** An adult male brown bear weighs about 1,380 pounds. An adult female brown bear weighs about 630 pounds. How much less does an adult female brown bear weigh than an adult male brown bear?
- Example 2 (p. 26)2. POOLS The table shows the total amount of water in a swimming pool that is being filled. At this rate, how much water will be in the swimming pool after 30 minutes?

Time (min)	5	10	15	20	25	30
Water (gal)	75	150	225	300		

Method of Computation To solve a problem, some methods you can choose are paper and pencil, mental math, a calculator, or estimation.



## Practice and Problem Solving

HOMEWORK HELP		
For Exercises	See Examples	
3, 4	1	
5, 6	2	

Standards • ISTEP+

Extra Practice, pp. 672, 706

## For Exercises 3–8, use the four-step plan to solve each problem.

- **3. RIVERS** The longest river in the world is the Nile River. It is 4,132 miles long. The longest river in the United States is the Missouri River. It is 2,540 miles long. How much longer is the Nile than the Missouri?
- 4. **ANALYZE GRAPHS** Refer to the graph. How many more people use the Internet in Europe than in Africa?
- 5. **PATTERNS** Complete the pattern: 5, 11, 17, 23, ■, ■, ■.
- SCHOOL The first five bells at Ed's middle school ring at 8:50 A.M., 8:54 A.M., 9:34 A.M., 9:38 A.M., and 10:18 A.M.





If this pattern continues, when should the next three bells ring?

- **7. MONEY** The Hamres are buying a new car. They will pay \$350 per month for 4 years. How much will they spend in all for the car?
- 8. WALKING Megan uses a pedometer to find how many steps she takes each school day. If she takes 6,482 steps on Monday, about how many steps will she take the entire school week?
- **H.O.T. Problems** 9. CHALLENGE Complete the pattern: 3, 3, 6, 18, 72, **...** 
  - **10. WRITING IN** MATH When using the four-step plan, explain why you should compare your answer to your estimate.

## ISTEP+ PRACTICE P.1.1

- 11. Michael can swim 8 laps in 4 minutes. At this rate, how long will it take him to swim 40 laps?
  - **A** 24 min **C** 15 min
  - **B** 20 min **D** 10 min
- 12. Find the next three numbers in the pattern below.

	57,49,	41,	33,
F	25, 17, 9	H	25, 18, 11
G	26, 18, 10	J	26, 17, 8

## GET READY for the Next Lesson

PREREQUISITE SKILL	<b>D1v1de.</b> (Page 658)
<b>13</b> . 42 ÷ 3	<b>14</b> . 126 ÷ 6

**15**. 49 ÷ 7

**16**. 118 ÷ 2







# **Prime Factors**

## **MAIN IDEA**

Find the prime factorization of a composite number.

#### **IN Academic Standards**

**Reinforcement of 5.1.3** Identify and explain prime and composite numbers.

#### **New Vocabulary**

factor prime number composite number prime factorization

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- Personal Tutor
- Self-Check Quiz
- · Reading in the Content Area

MINI Lab

Any given number of squares can be arranged into one or more different rectangles.

STEP Use a geoboard to make as many different rectangles as possible using two squares. Then repeat with four squares.





Number	Dimensions of
of Squares	Each Rectangle
2	1 x 2
3	
4	1 × 4, 2 × 2

 $\odot$ 

 $\odot$ 

1. For what numbers can more than one rectangle be formed?

- 2. For what numbers can only one rectangle be formed?
- 3. For the numbers in which only one rectangle is formed, what do you notice about the dimensions of the rectangle?

When two or more numbers are multiplied, each number is called a **factor** of the product.



A whole number that has exactly two unique factors, 1 and the number itself, is a **prime number**. A number greater than 1 with more than two factors is a **composite number**.



### **Reading Math**

Infinite Infinite means endless.

Prime and	Composite	Key Concept
Number	Definition	Examples
prime	A whole number that has exactly two factors, 1 and the number itself.	11, 13, 23
composite	A number greater than 1 with more than two factors.	6, 10, 18
neither prime nor composite	1 has only one factor. 0 has an infinite number of factors.	0, 1

## EXAMPLES Identify Prime and Composite Numbers

19

Tell whether each number is *prime*, *composite*, or *neither*.

#### 12

Factors of 12: 1, 2, 3, 4, 6, 12 Since 12 has more than two factors, it is a composite number.

Factors of 19: 1, 19 Since there are exactly two factors, 19 is a prime number.

**CHECK** Your Progress

nor composite

Tell whether each number is *prime*, *composite*, or *neither*.

a. 28	<b>b.</b> 11	<b>c.</b> 81

Every composite number can be expressed as a product of prime numbers. This is called a **prime factorization** of the number. A factor tree can be used to find the prime factorization of a number.

## EXAMPLE Find Prime Factorization

5) Find the prime factorization of 36.





**CHECK** Your Progress

Find the prime factorization of each number.

e. 72 **d.** 54



# Examples 1, 2<br/>(p. 29)Tell whether each number is prime, composite, or neither.1. 102. 33. 14. 61

Example 3 (p. 29) Find the prime factorization of each number.

**5**. 36

- **6**. 81 **7**. 65
- **9. GEOGRAPHY** The state of South Carolina has 46 counties. Write 46 as a product of primes.



8. 19

## Practice and Problem Solving

HOMEWORK HELP		
For Exercises	See Examples	
10–21, 36, 37	1, 2	
22–35	3	

Tell whether each number is *prime*, *composite*, or *neither*.

<b>10.</b> 17	<b>11.</b> 0	<b>12</b> . 15	<b>13</b> . 44
<b>14.</b> 23	<b>15</b> . 57	<b>16.</b> 45	17. 29
<b>18.</b> 56	<b>19.</b> 93	<b>20.</b> 53	<b>21</b> . 31

## Find the prime factorization of each number.

-			
<b>22</b> . 24	<b>23.</b> 18	<b>24.</b> 40	<b>25.</b> 75
<b>26.</b> 27	<b>27.</b> 32	<b>28</b> . 49	<b>29.</b> 25
30. 42	<b>31</b> . 104	<b>32</b> . 55	33. 77

# **ANALYZE TABLES** For Exercises 34–38, use the table that shows the average weights of popular dog breeds.

- **34**. Which weight(s) have a prime factorization of exactly three factors?
- **35**. Which weight(s) have a prime factorization with factors that are all the same number?
- **36**. Which dog breeds have weights that are prime numbers?

Breed	Weight (lb)	Breed	Weight (lb)
Cocker Spaniel	20	Siberian Husky	50
German Shepherd	81	Boxer	60
Labrador Retriever	67	Rottweiler	112
Beagle	25	Dalmatian	55
Golden Retriever	70	Poodle	57
Source: Dog Bree	d Info Center		

- **37**. Of the Beagle, Golden Retriever, Siberian Husky, Rottweiler, and Dalmatian breeds, which have weights that are composite numbers?
- **38**. Name three weights that have exactly two prime factors in common.

Academic Standards • ISTEP+	🔶 Tell whethe	er each number is <i>pr</i>	rime, composite, or	neither.
Extra Practice, pp. 672, 70	<b>6 39</b> . 125	<b>40</b> . 114	<b>41</b> . 179	<b>42</b> . 291



**43. POSTCARDS** Juliana bought packs of postcards that each had the same number of postcards. If she bought 20 postcards, find three possibilities for the number of packs and the number of postcards in each pack.

**H.O.T. Problems** 44. **OPEN ENDED** Select two prime numbers that are greater than 50 but

- **45. REASONING** All odd numbers greater than or equal to 7 can be expressed as the sum of three prime numbers. Which three prime numbers have a sum of 59? Justify your answer.
- **46. NUMBER SENSE** *Twin primes* are two prime numbers that are consecutive odd integers such as 3 and 5, 5 and 7, and 11 and 13. Find all of the twin primes that are less than 100.
- **47. CHALLENGE** A *counterexample* is an example that shows a statement is not true. Find a counterexample for the statement below. Explain your reasoning.

All even numbers are composite numbers.

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**48. WRITING IN** MATH Explain how you know a number is prime.



less than 100.

- **49**. Find the prime factorization of 225.
  - $\mathbf{A} \ 2 \times 3 \times 5 \times 5$
  - $\mathbf{B} \quad 3 \times 3 \times 3 \times 5 \times 5$
  - **C**  $3 \times 3 \times 5 \times 5$
  - **D**  $3 \times 5 \times 5 \times 7$
- **50**. Which number is *not* composite?
  - **F** 15
  - G 29 H 35
  - J 64

**51.** The volume of a rectangular prism can be found by multiplying the length, width, and height of the prism. Which of the following could be the possible dimensions of the rectangular prism below?



## **Spiral Review**

- **52. PATTERNS** Complete the pattern: 5, 7, 10, 14, 19, ■. (Lesson 1-1)
- **53. TIME** The Pintos family left their home at 11:45 A.M. They traveled 325 miles at 65 miles per hour. If they stopped for an hour to eat lunch, how many hours did it take them to reach their destination? (Lesson 1-1)

GET READY N	or the Next Lesson		
PREREQUISITE SKI	L Multiply. (Page 658)		
54. $2 \times 2 \times 2$	<b>55</b> . 5 × 5	56. $4 \times 4 \times 4$	<b>57</b> . 10 × 10 × 10



# **Powers and Exponents**

## **MAIN IDEA**

Use powers and exponents in expressions.

#### **IN Academic Standards**

**Preparation for 7.1.3** Recognize the prime factors of a number and find the prime factorization of whole numbers and write the results using exponents.

#### **New Vocabulary**

base exponent power squared cubed

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Fold a piece of paper in half and make one hole punch. Open the paper and count the number of holes. Copy the table below and record the results.

Any number can be written as a

product of prime factors.

MINI Lab



Number	Number	Prime
of Folds	of Holes	Factorization
1		
:		
5		
$\langle$	$\langle$	

- **STEP 2)** Find the prime factorization of the number of holes and record the results in the table.
- **STEP3** Fold another piece of paper in half twice. Then make one hole punch. Complete the table for two folds.
- (STEPA) Complete the table for three, four, and five folds.
- 1. What prime factors did you record?
- 2. How does the number of folds relate to the number of factors in the prime factorization of the number of holes?
- **3**. Write the prime factorization of the number of holes made if you folded it eight times.

A product of identical factors can be written using an exponent and a base. The **base** is the number used as a factor. The **exponent** indicates how many times the base is used as a factor.



When no exponent is given, it is understood to be 1. For example,  $5 = 5^1$ .

Numbers expressed using exponents are called **powers**. Numbers raised to the second or third power have special names.

Powers	Words
2 <sup>5</sup>	2 to the fifth power
3 <sup>2</sup>	3 to the second power or 3 squared
10 <sup>3</sup>	10 to the third power or 10 <b>cubed</b>

## EXAMPLES Write Powers and Products

## 1) Write $3 \times 3 \times 3 \times 3$ using an exponent.

The base is 3. Since 3 is used as a factor four times, the exponent is 4.

 $3 \times 3 \times 3 \times 3 = 3^4$ 

## $\overline{2}$ Write $4^5$ as a product of the same factor. Then find the value.

The base is 4. The exponent is 5. So, 4 is used as a factor five times.

Write as a power.

 $4^5 = 4 \times 4 \times 4 \times 4 \times 4$  Write  $4^5$  as a product. = 1,024 Multiply.

## CHECK Your Progress

Write each product using an exponent.

**b.**  $10 \times 10 \times 10 \times 10 \times 10$ 

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

**c.** 2<sup>3</sup>

a.  $7 \times 7 \times 7$ 

**d.**  $8^2$ 

## Real-World EXAMPLE

**ENVIRONMENT** In a recent year, about 10<sup>4</sup> youth across the United States participated in activities and events to care for Earth's environment. What is this number?

 $10^4 = 10 \times 10 \times 10 \times 10$  Write  $10^4$  as a product.

= 10,000 Multiply.

So, about 10,000 youth participated in these events.

## CHECK Your Progress

- e. **COASTLINES** Georgia has  $10^2$  miles of coastline. What is the value of  $10^2$ ?
- f. **TESTS** A multiple-choice test has 7 questions. If each question has 4 choices, there are 4<sup>7</sup> ways the test can be answered. What is the value of 4<sup>7</sup>?



**Calculator** You can use a calculator to evaluate powers. To find  $3^4$ , enter

3 A ENTER AL

The value of  $3^4$  is 81.



An environmentalist uses math to collect and analyze data from the environment they are studying.

#### IN Math Online

For more information, go to glencoe.com.





Exponents can be used to write the prime factorization of a number. Remember to write the prime factors in ascending order, that is, from least to greatest.

	whet the prime factorization.
$=$ $2^3 \times 3^2$	Write products of identical factors using exponent
135	
$135 = 3 \times 3 \times 3 \times 5$	Write the prime factorization.
$=$ $3^3 \times 5$	Write products of identical factors using exponents
300	
$300 = \mathbf{2 \times 2 \times 3 \times 5 \times 5}$	Write the prime factorization.
$= 2^2 \times 3 \times 5^2$	Write products of identical factors using exponents
CHECK Your Progress	



## Practice and Problem Solving

HOMEWORK HELP		
See Examples		
1		
2		
3		
4–6		

## Write each product using an exponent.

<b>10.</b> 9 × 9	11. $8 \times 8 \times 8 \times 8$
12. $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$	<b>13.</b> $5 \times 5 \times 5 \times 5 \times 5$
<b>14</b> . 11 × 11 × 11	<b>15.</b> $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$

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

<b>16.</b> $10^3$	<b>17.</b> 3 <sup>2</sup>	<b>18</b> . 5 <sup>4</sup>	<b>19</b> . 10 <sup>5</sup>
<b>20.</b> 9 <sup>3</sup>	<b>21.</b> 6 <sup>5</sup>	<b>22.</b> 10 <sup>1</sup>	<b>23.</b> 1 <sup>7</sup>

- **24. FOOD** The number of Calories in two pancakes can be written as  $7^3$ . What whole number does  $7^3$  represent?
- **25. TEETH** A single tusk that weighed just over  $2^8$  pounds from an African elephant is the largest tooth ever recorded from any modern animal. About how many pounds did the tusk weigh?

## Write the prime factorization of each number using exponents.

<b>26.</b> 25	<b>27.</b> 56	<b>28</b> . 50	<b>29</b> . 68
<b>30.</b> 88	<b>31</b> . 98	<b>32.</b> 560	<b>33</b> . 378

34. **BIRDS** To find the amount of space a cube-shaped bird cage holds, find the *cube* of the measure of one side of the bird cage. Express the amount of space occupied by the bird cage shown as a power. Then find the amount in cubic units.



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

**35**. seven squared **36**. eight cubed

**37**. four to the fifth power

- 38. **GARDENING** Mrs. Ramirez's garden is organized into 6 rows. Each row contains 6 vegetable plants. How many total vegetable plants does Mrs. Ramirez have in her garden? Write using exponents, and then find the value.
- **39. HOBBIES** A knitted scarf is made by joining 20 square blocks that are each made up of 20 rows of 20 stitches. How many total stitches does the Extra Practice, pp. 672, 706 scarf contain? Write using exponents, and then find the value.

H.O.T. Problems **40. OPEN ENDED** Write a power whose value is greater than 100.

41. **NUMBER SENSE** Which is greater: 3<sup>5</sup> or 5<sup>3</sup>? Explain your reasoning.

Academic Standards • ISTEP+



**42. FIND THE ERROR** Marissa and Rashaun are finding the value of  $7^3$ . Who is correct? Explain your reasoning.  $7^3 = 7 \times 7 \times 7$ = 343  $7^3 = 7 \times 3$ = 21 Marissa Rashaun **CHALLENGE** For Exercises 43–45, Powers of 3 Powers of 5 **Powers of 10** refer to the table at the right.  $3^4 = 81$ 5<sup>4</sup> = 625  $10^4 = 10,000$  $3^3 = 27$  $5^3 = 125$  $10^3 = 1,000$ **43**. Describe the pattern for the  $3^2 = 9$  $5^2 = 25$  $10^2 =$ powers of 3. Find  $3^0$ . 100  $3^1 = 3$  $5^1 = 5$  $10^1 =$ 44. Describe the pattern for the **3**<sup>0</sup> = **■** 5<sup>0</sup> = 10<sup>0</sup> = powers of 5. Find  $5^0$ . 45. Describe the pattern for the powers of 10. Find  $10^1$  and  $10^0$ . 46. WRITING IN MATH Explain how to find 10<sup>6</sup> mentally. **ISTEP+ PRACTICE** Preparation for 7.1.3 47. If the pattern of figures continues, **48**. Which is the prime factorization of 360? which value represents the seventh figure in the pattern?  $F 2^2 \times 3 \times 5^2$ **G**  $2^3 \times 3^2 \times 5$ H  $2^2 \times 3^3 \times 5$ I  $2 \times 3^2 \times 5$ 12 22  $3^{2}$ **A**  $7^2$  $C 7^7$ **B** 1<sup>7</sup> **D**  $3^7$ **Spiral Review** Tell whether each number is prime, composite, or neither. (Lesson 1-2) **49**. 63 **50**. () 51. 29 **52**. 71 **53. TIME** Find the number of seconds in a day if there are 60 seconds in a minute. (Lesson 1-1) GET READY for the Next Lesson **PREREQUISITE SKILL** Divide. (Page 744) **54**. 36 ÷ 3 **55**. 45 ÷ 5 **56**. 104 ÷ 8 **57.** 120 ÷ 6 Chapter 1 Algebra: Number Patterns and Functions







# **Order of Operations**

## **MAIN IDEA**

Find the value of expressions using the order of operations.

#### **IN Academic Standards**

6.2.3 Apply the correct order of operations and the properties of real numbers [identity, inverse, commutative, associative and distributive properties] to evaluate numerical expressions, including those that use grouping symbols such as parentheses. Justify each step in the process.

#### **New Vocabulary**

numerical expression order of operations

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## GET READY for the Lesson

**SNACKS** The table shows the cost of different snacks at a concession stand.

- 1. How much would 3 boxes of popcorn cost? 4 sandwiches?
- 2. Find the total cost of buying 3 boxes of popcorn and 4 sandwiches.



**3**. What two operations did you use in Questions 1 and 2? Explain how to find the answer to Question 2 using these operations.

A **numerical expression** like  $3 \times 2 + 4 \times 4$  is a combination of numbers and operations. The **order of operations** tells you which operation to perform first so that everyone finds the same value for an expression.

## **Order of Operations**

Key Concept

- 1. Simplify the expressions inside grouping symbols, like parentheses.
- **2.** Find the value of all powers.
- 3. Multiply and divide in order from left to right.
- 4. Add and subtract in order from left to right.

## EXAMPLES Use Order of Operations

#### Find the value of each expression.

D	4	+	3	×	5		

 $4 + 3 \times 5$ = 4 + 15 Multiply 3 and 5. = 19 Add 4 and 15.

2 10 - 2 + 8 10 - 2 + 8 = 8 + 8 = 16

 $= \frac{8}{16} + 8$  Subtract 2 from 10 first. = 16 Add 8 and 8.

## CHECK Your Progress

Find the value of each expression.

a.  $10 + 2 \times 15$ 

**b.**  $16 \div 2 \times 4$ 

#### EXAMPLES Parentheses and Exponents Find the value of each expression. 3) $20 \div 4 + 17 \times (9 - 6)$ $20 \div 4 + 17 \times (9 - 6) = 20 \div 4 + 17 \times 3$ Subtract 6 from 9. $= 5 + 17 \times 3$ Divide 20 by 4. = 5 + 51Multiply 17 by 3. = 56Add 5 and 51. (1) $3 \times 6^2 + 4$ $3 \times 6^2 + 4 = 3 \times 36 + 4$ Find 6<sup>2</sup>. = 108 + 4Multiply 3 and 36. = 112Add 108 and 4.

## CHECK Your Progress

Find the value of each expression.

c.  $25 \times (5-2) \div 5 - 12$  d.  $24 \div 2^3 + 6$ 

## Real-World EXAMPLE

**SHOPPING** A bath and body store sells lotions for \$5, candles for \$7, and lip balms for \$2. Write an expression for the total cost of 3 lotions, 2 candles, and 4 lip balms. Then find the total cost.

Cost of Items			
ltem	lotion	candle	lip balm
Cost (\$)	5	7	2

To find the total cost, write an expression and then find its value.



 $3 \times \$5 + 2 \times \$7 + 4 \times \$2$ 

 $= \$15 + 2 \times \$7 + 4 \times \$2$  Multiply 3 and 5. = \\$15 + \\$14 + 4 × \\$2 Multiply 2 and 7. = \$15 + \$14 + \$8 Multiply 4 and 2. = \$37

The total cost of the items is \$37.

## CHECK Your Progress

e. **SNACKS** Alexis and 3 friends are shopping at the mall. They decide to stop for a snack. Each person buys a hot pretzel for \$3, a dipping sauce for \$1, and a drink for \$2. Write an expression for the total cost of the snacks. Then find the total cost.







Real-World Link ..... The largest hot pretzel ever baked weighed 40 pounds and was 5 feet across. Source: Der Pretzel Haus

## CHECK Your Understanding

Examples 1–4

Find the value of each expression.

- (pp. 37–38) 1. 9 + 3 5
  - 3.  $(26 + 5) \times 2 15$ 5.  $5^2 + 8 \div 2$

2. 10 - 3 + 94.  $18 \div (2 + 7) \times 2 + 1$ 6.  $19 - (3^2 + 4) + 6$ 

- Example 5 (p. 38)
- THEATER Tickets to a play cost \$10 for members and \$24 for nonmembers. Write an expression to find the total cost of 4 nonmember tickets and 2 member tickets. Then find the total cost.

## Practice and Problem Solving

8. 10. 12. 14. 16. 18. 20.

HOMEWORK HELF		
For Exercises	See Examples	
8-11	1, 2	
12–17	3	
18–21	4	
22, 23	5	

Find the value of each expression.

8 + 4 - 3	<b>9</b> . $9 + 12 - 15$
38 - 19 + 12	<b>11</b> . 22 - 17 + 8
$7 + 9 \times (3 + 8)$	<b>13</b> . $(9+2) \times 6 - 5$
$63 \div (10 - 3) \times 3$	<b>15.</b> $66 \times (6 \div 2) + 1$
$27 \div (3+6) \times 5 - 12$	<b>17</b> . 55 ÷ 11 + 7 × (2 + 14)
$5^3 - 12 \div 3$	<b>19.</b> $26 + 6^2 \div 4$
$15 - 2^3 \div 4$	<b>21.</b> $22 \div 2 \times 3^2$

- **22. TICKETS** Admission to a circus is \$16 for adults and \$10 for children. Write an expression to find the total cost of 3 adult tickets and 4 children's tickets. Then find the total cost.
- **23. MOVIES** Tyree and four friends go to the movies. Each person buys a movie ticket for \$7, a snack for \$3, and a drink for \$2. Write an expression for the total cost of the trip to the movies. Then find the total cost.

## Find the value of each expression.

24.	$8 \times (2^4 - 3) + 8$	<b>25.</b> $12 \div 4 + (5^2 - 6)$
26.	$9 + 4^3 \times (20 - 8) \div 2 + 6$	<b>27.</b> $96 \div 4^2 + (25 \times 2) - 15 - 3$

**28. APPLES** Addison is making caramel covered apples for 15 friends. She has covered 3 dozen apples. If she wants each friend to receive exactly 3 apples and have no apples left over, write an expression to find how many more apples she should cover. Then find this number.

## Write a numerical expression for each verbal expression. Then find its value.

- Academic ISTEP+ Extra Practice, pp. 673, 706
- **29**. the product of 7 and 6, minus 2
- **30**. the cube of the quotient of 24 and 6



# **H.O.T. Problems 31. CHALLENGE** Create an expression with a value of 10. It should contain four numbers and two different operations.

**32. FIND THE ERROR** Miranda and Dalton are finding 9 - 6 + 2. Who is correct? Explain your reasoning.



**33. WRITING IN** MATH Write a real-world problem that can be solved using order of operations. Then solve the problem.



## ISTEP+ PRACTICE 6.2.3

**34**. Arleta is 2 years younger than Josh, and Josh is 5 years older than Monica, who is 9 years old. Which table could be used to find Arleta's age?

Α	Name	Age (years)
	Arleta	9 + 5
	Josh	9 + 5 - 2
	Monica	9

B	Name	Age (years)
	Arleta	2
	Josh	5
	Monica	9
	Monica	9

С	Name	Age (years)
	Arleta	5
	Josh	4
	Monica	9

D	Name	Age (years)
	Arleta	9 + 5 - 2
	Josh	9 + 5
	Monica	9

**43**. 54 + 6



**35. PHONE TREE** Four members of a certain phone tree are each given 4 people to contact. If the phone tree is activated, the total number of calls made is 4<sup>4</sup>. How many calls is this? (Lesson 1-3)

Find the prim	ne factorization of eac	h number. (Lesson 1-2)	
<b>36</b> . 42	<b>37</b> . 75	<b>38.</b> 110	<b>39</b> . 130
GETREAD	for the Next Lesson		
PREREQUISITE	SKILL Add. (Page 743)		

**42**. 61 + 19

**41**. 23 + 16

**40**. 26 + 98

# **Mid-Chapter Quiz**



Lessons 1-1 through 1-4

**IN Academic Standards** 6.2.3, P.1.1

1. **BOOKS** Hugo needs to finish reading a 465-page book by Sunday. The number of pages he read each day are shown in the table. How many pages will he need to read on Saturday and Sunday in order to finish the book in time? (Lesson 1-1)

Day	Number of Pages
Monday	60
Tuesday	72
Wednesday	59
Thursday	85
Friday	67

- 2. MULTIPLE CHOICE A school has 144 computers in 24 classrooms. How many computers are in each classroom if each classroom has the same number of computers? (Lesson 1-1)
  - **A** 6
  - **B** 24
  - **C** 120
  - **D** 3,456

Tell whether each number is *prime*, composite, or neither. (Lesson 1-2)

- 4.97
- 5. 0
- 6. **BOOKS** Can a group of 41 books be placed onto more than one shelf so that each shelf has the same number of books and has more than one book per shelf? Explain your reasoning. (Lesson 1-2)

## Write each power as a product of the same factor. Then find the value. (Lesson 1-3)

**7.** 3<sup>4</sup> **8**. 6<sup>3</sup>

## Write the prime factorization of each number using exponents. (Lesson 1-3)

9.	22	<b>10</b> . 40	<b>11</b> . 75

**12. DOGS** The average annual cost of food for a dog is about 3<sup>5</sup> dollars. What is this cost? (Lesson 1-3)

Find the value of each expression. (Lesson 1-4)

- **13.** 10 6 + 2014.  $25 \div (15 - 10) \times 2$ 15.  $3^2 + 32 \div 2$ **16.**  $12 - (4^3 \div 8) + 1$
- 17. **MULTIPLE CHOICE** Mr. and Mrs. Murphy and their 4 children went to the county fair. Admission to the fair was \$7.75 for an adult and \$5.50 for a child. Arrange the problem-solving steps below in the correct order to find the total cost of the tickets.
  - Step K: Multiply the cost of a child's ticket by the number of children.
  - Step L: Add the two products together.
  - Step M: Multiply the cost of an adult ticket by the number of adults.
  - Step N: Write down the number of adults and the number of children that are going to the county fair.

Which list shows the steps in the correct order? (Lesson 1-4)

- **F** N, L, M, K **G** N, M, K, L **H** K, M, N, L
- J M, K, N, L



# Algebra: Variables and Expressions

## **MAIN IDEA**

Evaluate algebraic expressions.

#### **IN Academic Standards**

6.2.3 Apply the correct order of operations and the properties of real numbers [identity, inverse, commutative, associative and distributive properties] to evaluate numerical expressions, including those that use grouping symbols such as parentheses. Justify each step in the process.

## **New Vocabulary**

algebra variable algebraic expression evaluate

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#### Vocabulary Link . . . Variable

**Everyday Use** able to change or vary, as in variable winds **Math Use** a symbol used to represent a number

## GET READY for the Lesson

**ART SUPPLIES** A box contains some crayons. There are also two crayons outside of the box. The total number of crayons is *the sum of two and some number*. The two crayons represent the value 2, and the box represents the unknown value.

1. What does *some number* represent?

- **2**. Find the value of the expression *the sum of two and some number* if *some number* is 14.
- **3**. Assume you have two boxes of crayons each with the same number of crayons inside. Write an expression that represents the total number of crayons in both boxes.

• **Algebra** is a language of symbols, including variables. A **variable** is a symbol, usually a letter, used to represent a number. The expression 2 + n represents *the sum of two and some number*.

Algebraic expressions are combinations of variables, numbers, and at least one operation.



The letter *x* is often used as a variable. It is also common to use the first letter of the value you are representing.

The variables in an expression can be replaced with any number. Once the variables have been replaced, you can **evaluate**, or find the value of, the algebraic expression.

In addition to the symbol  $\times$ , there are other ways to show multiplication.



EXAMPLES Evaluate Algebraic Expressions **D** Evaluate 16 + b if b = 25.

16 + b = 16 + 25Replace *b* with 25. = 41Add 16 and 25.

2) Evaluate x - y if x = 64 and y = 27.

x - y = 64 - 27Replace x with 64 and y with 27. Subtract 27 from 64.

Evaluate 5t + 4 if t = 3.

= 37

$5\mathbf{t} + 4 = 5 \cdot 3 + 4$	Replace t with 3.
= 15 + 4	Multiply 5 and 3.
= 19	Add 15 and 4.

Multiplication In algebra,

the symbol • is often used to represent multiplication, as the symbol X may be confused with the variable x.

## **CHECK** Your Progress

Evaluate each expression if a = 6 and b = 4. **b**. a - b**c**. *a* • *b* d. 2a - 5**a**. *a* + 8

## ISTEP+ EXAMPLE > 6.2.3

4) An expression for finding the area of a triangle that has a height 3 units longer than its base is  $(b + 3) \cdot b \div 2$ , where *b* is the measure of the base. Find the area of such a triangle with a base 8 units long.

A 20 units<sup>2</sup> **B** 25 units<sup>2</sup>  $\mathbf{C}$  44 units<sup>2</sup> **D** 88 units<sup>2</sup>

## **Read the Item**

You need to find the value of the expression given b = 8.

## Solve the Item

 $(b + 3) \cdot b \div 2 = (8 + 3) \cdot 8 \div 2$  Replace *b* with 8.  $= 11 \cdot 8 \div 2$ Add 8 and 3.  $= 88 \div 2$ Multiply 11 and 8. = 44Divide 88 by 2.

The area of the triangle is 44 units<sup>2</sup>. The answer is C.

## **CHECK** Your Progress

e. If admission to a fair is \$7 per person and each ride ticket costs \$2, the total cost for admission and t ride tickets is 7 + 2t. Find the total cost for admission and 5 ride tickets.

**F** \$9 **G** \$17 H \$35 J \$45

#### Test-Taking Tip

**Preparing for the Test** In preparation for the test, it is often helpful to familiarize yourself with important formulas or rules such as the rules for order of operations.



	HEO	< Your Unde	rstanding	
Exa	mples 1–3	Evaluate each	expression if $m = 4$ and $z =$	9.
	(p. 43)	<b>1</b> . 3 + <i>m</i>	<b>2.</b> <i>z</i>	+ 5
		<b>3.</b> <i>z</i> – <i>m</i>	<b>4</b> . <i>m</i>	- 2
		<b>5.</b> 4 <i>m</i> − 2	<b>6.</b> 2z	z + 3
E	Example 4 (p. 43)	7. <b>MULTIPLE CF</b> \$20 dollar b is $20 - 4p$ . 1	<b>IOICE</b> The amount of money bill after Malina buys 4 party Find the amount remaining i	that remains from a favors for <i>p</i> dollars each f each favor costs \$3.
		<b>A</b> \$4	<b>C</b> \$1	17
		<b>B</b> \$8	<b>D</b> \$4	18
Pr	actice	and <b>Proble</b> Evaluate each	EXAMPLE A SOLVING EXPRESSION IF $m = 2$ and $n = 2$	16.
For	See	<b>8</b> . <i>m</i> + 10	<b>9</b> . <i>n</i> + 8	<b>10.</b> 9 - m
Exercises	Examples	<b>11</b> . 22 – <i>n</i>	<b>12</b> . <i>n</i> ÷ 4	<b>13</b> . 12 ÷ <i>m</i>
8–19 20–27	1,2	<b>14</b> . <i>n</i> • 3	<b>15</b> . 6 • <i>m</i>	<b>16</b> . <i>m</i> + <i>n</i>
51-53	4	<b>17</b> . <i>n</i> + <i>m</i>	<b>18</b> . <i>n</i> – 6	<b>19</b> . <i>m</i> – 1

Evaluate each expression if a = 4, b = 7, and c = 11.

20.	b-a	<b>21</b> . <i>c</i> – <i>b</i>	22.	5c + 6
23.	2b + 7	<b>24.</b> 3 <i>a</i> - 4	25.	4b - 10

- **26. BAMBOO** To find the amount a bamboo plant can grow in a certain amount of time, use the expression *rt*, where *r* represents rate and *t* represents time. How many feet can a bamboo plant grow in seven days at a rate of 3 feet per day?
- : 27. **RACING** To find the average speed of a racecar, use the expression  $d \div t$ , where *d* represents distance and *t* represents time. Find the speed *s* of a racecar that travels 508 miles in 4 hours.

Evaluate each expression if a = 4, b = 15, and c = 9. **29.**  $b^2 - 5c$ **28.**  $c^2 + a$ **30**. 3*a* ÷ 4 **31**. 4*b* ÷ 5 **32**. 5*b* • 2 **33**. 2*ac* 

34. If y = 4, what is the value of 5y - 3?

**35.** What is the value of  $st \div 6r$  if r = 5, s = 32, and t = 45?

**36. PLANES** The expression 500*t* can be used to find the distance traveled by a DC-10 aircraft. The variable *t* represents time in hours. How far can a DC-10 travel in 4 hours?



Real-World Link... The average speed at the 2007 Daytona 500 was 149.3 mph. Source: NASCAR

H



<b>37.</b> $4z + 8 - 6$	<b>38.</b> $6x - 9 \div 3$
<b>39.</b> $15 + 9x \div 3$	<b>40.</b> $7z \div 4 + 5x$
<b>41.</b> $y^2 \div (3z)$	<b>42.</b> $z^2 - (5x)$

**43. GEOMETRY** To find the area of a rectangle, use the expression  $\ell w$ , where  $\ell$  represents the length, and w represents the width of the rectangle. What is the area of the rectangle shown?

7 ft

- **44. MUSIC** As a member of a music club, you can order CDs for \$15 each. The music club also charges \$5 for each shipment. The expression 15n + 5 represents the cost of *n* CDs. Find the total cost for ordering 3 CDs.
- **45. ANALYZE TABLES** To change a temperature given in degrees Celsius to degrees Fahrenheit, first multiply the Celsius temperature by 9. Next, divide the answer by 5. Finally, add 32 to the result. Write an expression that can be used to change a temperature from degrees Celsius to degrees Fahrenheit. Then use the information in the table below to find the difference in average temperatures in degrees Fahrenheit for San Antonio from January to April. (*Hint:* Convert to degrees Fahrenheit first.)

Average Month for San An	lly Temperature tonio, Texas	
Month	Temp. (°C)	
January	10	
April	20	
July	29	1



H.O.T. Problems

- **46. OPEN ENDED** Create two algebraic expressions involving multiplication that have the same meaning.
- **47. CHALLENGE** Marcus and Yvette each have a calculator. Yvette starts at 100 and subtracts 7 each time. Marcus starts at zero and adds 3 each time. Suppose Marcus and Yvette press the keys at the same time. Will their displays ever show the same number? If so, what is the number? Explain your reasoning.
- **48. SELECT A TECHNIQUE** Ichiro is evaluating  $x^2 z$ , where x = 3 and z = 8. Which of the following techniques might Ichiro use to evaluate the expression? Justify your selection(s). Then use the technique(s) to solve the problem.

```
mental math
```

```
number sense
```

estimation







49. Which One Doesn't Belong? Identify the expression that does not belong with the other three. Explain your reasoning.



50. WRITING IN MATH Compare and contrast numerical expressions and algebraic expressions. Use examples in your explanation.

## ISTEP+ PRACTICE > 6.2.3

51. The height of the triangle below can be found using the expression  $48 \div b$ where *b* is the base of the triangle. Find the height of the triangle.



**52. SHORT RESPONSE** The expression 4*s* can be used to find the perimeter of a square where *s* represents the length of a side. What is the perimeter in inches of a square with a side length of 26 inches?

53. The table shows the total medal counts for different countries from the 2006 Winter Olympic games.

Total Medal Count			
Country	Number of Medals		
Germany	29		
United States	25		
Canada	X		
Austria	23		
Russia	22		
Norway	19		

Source: International Olympic Committee

Which expression represents the total number of medals earned by all the countries listed in the table?

F	118 - x	<b>H</b> $x - 118$
G	2x + 118	<b>J</b> 118 + <i>x</i>



## Find the value of each expression. (Lesson 1-4)

- 54.  $12 8 \div 2 + 1$

**55.**  $5^2 + (20 \div 2) - 7$  **56.**  $21 \div (3 + 4) \times 3 - 8$ 

- 57. LANGUAGE An estimated  $10^9$  people in the world speak Mandarin Chinese. About how many people speak this language? (Lesson 1-3)
- 58. **TESTS** On a test with 62 questions, Trey missed 4 questions. How many did he get correct? (Lesson 1-1)



## Explore 1-6

## **MAIN IDEA**

Illustrate functions using technology.

#### **IN Academic Standards**

6.2.5 Solve problems involving linear functions with integer values. Create a table and graph the resulting ordered pairs of integers on a grid. Look for patterns in how a change in one variable relates to a change in the second variable and write the equation.

## **IN Math Online**

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Other Calculator Keystrokes

## Graphing Calculator Lab Function Machines

A *function machine* takes a value called the *input* and performs one or more operations on it according to a rule to produce a new value called the *output*.



Another way to write the rule of a function machine is as an algebraic expression. For the function machine above, an input value of x produces an output value of x + 3. You can use the TI-83/84 Plus graphing calculator to model this function machine.

## ACTIVITY

Use a graphing calculator to model a function machine for the rule x + 3. Then use this machine to find the output values for the input values 2, 3, 4, 9, and 12.

The graphing calculator uses X for input and Y for output values.

**STEP1** Enter the rule for the function into the function list. Press Y= to access the function list. Then press  $X,T,\theta,n$  + 3 to enter the rule.



STEP2 Next, set up a table of input and output values. Press 2nd [TBLSET] to display the table setup screen. Press ↓ ↓ → ENTER to highlight Indpnt: Ask. Then press ↓ ENTER to highlight Depend: Auto.



(continued on the next page)



STEP3 Access the table by pressing 2nd [TABLE]. The calculator will display an empty function table.

STEP 4 Now key in your input values, pressing ENTER after each one.



## CHECK Your Progress

Use a graphing calculator to model a function machine for each of the following rules. Use the input values 5, 6, 7, and 8 for x. Record the inputs and their corresponding outputs in a table.

a. <i>x</i> – 4	<b>b</b> . <i>x</i> + 5	<b>c</b> . <i>x</i> − 2
<b>d</b> . <i>x</i> − 3	e. <i>x</i> • 2	f. <i>x</i> • 3

## **ANALYZE THE RESULTS**

- 1. Examine the columns of inputs and outputs for Exercises a–d. What pattern do you observe in the column of inputs? What pattern do you observe in each column of outputs?
- 2. How would each column of outputs change if the order of the inputs was reversed to be 8, 7, 6, and 5?
- 3. Examine the columns of inputs and outputs for Exercises e and f. What patterns do you observe in the column of outputs?
- 4. Compare the patterns you observed in Exercise 3 to the rules given for Exercises e and f. What do you notice?

**MAKE A CONJECTURE** Based on your observations from Exercises 1–4, make a conjecture about the rule for each set of input and output values. Explain your reasoning.

5.	Input ( <i>x</i> )	Output (y)
	10	2
	11	3
	12	4
	13	5
	14	6

6.	Input (x)	Output (y)
	2	12
	3	18
	4	24
	5	30
	6	36





# **Algebra: Functions**

## **MAIN IDEA**

Complete function tables and find function rules.

#### **IN Academic Standards**

6.2.5 Solve problems involving linear functions with integer values. Create a table and graph the resulting ordered pairs of integers on a grid. Look for patterns in how a change in one variable relates to a change in the second variable and write the equation. Also addresses P.7.1.

#### **New Vocabulary**

function function table function rule defining the variable

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## **GET READY for the Lesson**

**SCIENCE** A ruby-throated hummingbird beats its wings about 52 beats per second.

1. Write an expression to represent the number of times this bird beats its wings in 2 seconds, in 6 seconds, and in *s* seconds.



A **function** is a relationship that assigns exactly one output value to one input value. The number of wing beats (output) depends on the number of seconds (input). You can organize the input-output values in a **function table**.

Input	Function Rule	Output
Number of Seconds (s)	525	Wing Beats
1	52(1)	52
2	52(2)	104
3	52(3)	156

The function rule describes the relationship between each input and output.

## EXAMPLE Complete a Function Table

The output is 7 more than the input. Complete a function table for this relationship.

The function rule is x + 7. Add 7 to each input.



Input ( <i>x</i> )	Output $(x + 7)$
10	17
12	19
14	21

## **CHECK** Your Progress

Copy and complete each function table.

a.	Input ( <i>x</i> )	Output $(x - 4)$
	4	
	7	
	10	

b.	Input ( <i>x</i> )	Output (3x)
	0	
	2	
	5	



Check for Reasonableness To see if your function rule is correct, test more than one input value.



## Find the Rule for a Function Table

## Pind the rule for the function table.

Study the relationship between each input and output. Each output is three times the input.

So, the function rule is  $3 \cdot x$ , or 3x.

## **CHECK** Your Progress

Find the rule for each function table.

C.	Input ( <i>x</i> )	Output (	d.	Input (x)	Output (
	0	0		4	1
	4	1		8	5
	16	4		10	7

When you write a function rule that represents a real-world situation, you first choose a variable to represent the input. This is called defining the variable.

## Real-World EXAMPLE

**MUSIC** A local band charges \$70 for each hour it performs. Define a variable. Then write a function rule that relates the total charge to the number of hours it performs.

Determine the function rule. The cost of the performance depends on the number of hours. Let *h* represent the number of hours.



The function rule is 70*h*.

## **CHECK** Your Progress

e. SHOPPING A department store is deducting \$10 off the total purchase for shoppers from 6 A.M. to 7 A.M. Define a variable. Write a function rule that relates the final cost to the total purchase amount.





sounded by striking, shaking, plucking, or

scraping. There are over 52 different

kinds of percussion

Source: Virginia Tech Multimedia

instruments.

Music Dictionary



50 Chapter 1 Algebra: Number Patterns and Functions



# CHECK Your Understanding

1.

3.

Example 1

## Copy and complete each function table.

Find the rule for each function table.

(p. 49)	
---------	--

Input (x)	Output $(x + 3)$
0	
2	
4	

2.	Input ( <i>x</i> )	Output (4x)
	1	
	3	
	6	

## Example 2

(p. 50)

X		ľ
1	0	
3	2	
5	4	

4.	x	
	0	0
	3	6
	6	12

Example 3 (p. 50) **5. JELLY BEANS** Lamar is buying jelly beans for a party. He can buy them in bulk for \$3 a pound. Define a variable. Write a function rule that relates the total cost of the jelly beans to the number of pounds he buys.

## Practice and Problem Solving

HOMEWORK HELP	
For Exercises	See Examples
6–7	1
8–13	2
14, 15	3

## Copy and complete each function table.

6.	Input (x)	Output $(x - 4)$
	4	
	8	
	11	

7.	Input ( <i>x</i> )	Output ( $x \div 3$ )
	0	
	3	
	9	

## Find the rule for each function table.



- 14. **AGES** Ricardo is 8 years older than his sister. Define a variable. Write a function rule that relates Ricardo's age to his sister's age.
- **15. FOOD** Whitney has a total of 30 cupcakes for her guests. Define a variable. Write a function rule that relates the number of cupcakes per guest to the number of guests.



Find the rule for each function table.

16.	x		17.	x		18.	x	
	2	2		0	1		3	13
	3	5		1	7		6	28
	4	8		2	13		9	43
	5	11		3	19		12	58

For Exercises 19–21, define a variable and write a function rule. Then solve each problem.

- **19. ANIMALS** Moose can swim up to 6 miles per hour. At this rate, find the total number of miles a moose could swim in two hours.
- **20. MONEY** Kyle is buying 7 greeting cards that cost \$2 each. If he has a coupon for \$3 off his total purchase, how much will he spend for the greeting cards?
- **21. MUSIC** An Internet company charges \$10 a year to be a member of its music program. It also charges \$1 for each song you download. How much will it cost if you download 46 songs in a year?
- **22. FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write about a real-world situation that can be described by a function rule.
- 23. TICKETS The science club is going on a field trip to the zoo. Student tickets are \$6.00 each and adult tickets are \$9.00 each. Write a function rule to represent the total cost of *s* student tickets and *a* adult tickets. Then use the function rule to find the cost for 8 students and 3 adults.

Zoo Admission Rates				
Ticket	Price			
Adult	\$9.00			
Student	\$6.00			

Academic • ISTEP+ Standards • ISTEP+ Extra Practice, pp. 673, 706

**H.O.T. Problems** 24. **OPEN ENDED** Create a function table. Then write a function rule. Choose three input values and find the output values.

**25. FIND THE ERROR** Nadia and Caitlyn are finding the function rule when each output is 3 less than the input. Who is correct? Explain.









- **26. CHALLENGE** Around 223 million Americans keep containers filled with coins in their home. Suppose each of the 223 million people started putting their coins back into circulation at a rate of \$10 per year. Create a function table that shows the amount of money that would be recirculated in 1, 2, and 3 years.
- **27. SELECT A TOOL** Courtney is evaluating the function rule 43x 6 for an input of 4. Which of the following tools might Courtney use to determine the output? Justify your selection(s). Then use the tool(s) to solve the problem.



**28. WRITING IN MATH** Explain how to find a function rule given a function table.



## ISTEP+ PRACTICE 6.2.5

**29**. Which expression best represents the *y* values in terms of the *x* values?

	x	1	2	3	4	5	6	
	Y	5	7	9	11	13	15	
A	2x + 3				<b>C</b> 3 <i>x</i> − 2			-
B	<i>x</i> + 3				D	6 —	x	

- **30**. A store makes a profit of \$5 for each shirt sold. Which expression best represents the profit on 25 shirts?
  - F $5 \times 25$ H $25 \div 5$ G5 + 25J25 5

Spiral	Review

Evaluate each expression if a = 3, b = 6, and c = 10. (Lesson 1-5)

- **31.** b a **32.** 3c + a **33.** bc + 12
- **34. FOOD** A deli sells wraps for \$5 and soup for \$3 a bowl. Write and solve an expression for the cost of 3 wraps and 2 bowls of soup. (Lesson 1-4)
- **35. AREA CODES** California has 5<sup>2</sup> area codes. What is the value of 5<sup>2</sup>? (Lesson 1-3)

## GET READY for the Next Lesson

. .

**36. PREREQUISITE SKILL** The table represents the average amounts consumers spent on back-to-school merchandise in a recent year. How much more did consumers spend on clothing, accessories, and shoes than on school supplies? Use the four-step plan. (Lesson 1-1)

Back-to-School Spending			
Merchandise	Amount (\$)		
Clothing/Accessories	219		
Electronic Equipment	101		
Shoes	90		
School Supplies	73		

Source: USA Today





Academic

# **Problem-Solving Investigation**

**MAIN IDEA:** Solve problems by using the guess and check strategy.

P.1.3 Apply and adapt a variety of appropriate strategies to solve problems. P.1.4 Monitor and reflect on the process of **Standards** mathematical problem solving. Also addresses P.2.2.

## P.S.I. TERM +



#### GUESS AND CHECK e-Mail:

DARIUS: For my birthday, I received \$100 from my relatives. All of the money was in \$10 bills and \$20 bills. When I put the money in my savings account, I deposited 8 bills.

YOUR MISSION: Use guess and check to find how many of each bill Darius received for his birthday.



Understand	You kno number	You know that Darius has \$100 in \$10 bills and \$20 bills. You need to find the number of each bill he has.					
<b>Plan</b>	Make a	Make a guess until you find an answer that makes sense for the problem.					
Solve	Number of \$10 billsNumber of \$20 billsTotal Amount						
		7   1   7(\$10) + 1(\$20) = \$90			too low		
		4	4	4(\$10) + 4(\$20) = \$120	too high		
		5   3   5(\$10) + 3(\$20) = \$1		5(\$10) + 3(\$20) = \$110	still too high		
		6         2         6(\$10) + 2(\$20) = \$100			v		
	So, Darius received six \$10 bills and two \$20 bills.						
Check	Six \$10 bills equals \$60 and two \$20 bills equals \$40. Since $60 + 40 = 100$ , the answer is correct.						

## Analyze The Strategy

- 1. Explain when to use the *guess and check* strategy to solve a problem.
- 2. WRITING IN MATH Write a problem that can be solved using guess and check. Then tell the steps you would take to find the solution of the problem.



## **Mixed Problem Soluing**

Use the *guess and check* strategy to solve Exercises 3–6.

- 3. **COMICS** A comic book store sells used comic books in packages of 5 and new comic books in packages of 3. If Monica buys a total of 16 comic books, how many packages of new and used comic books did she buy?
- 4. **QUIZZES** On a science quiz, Ivan earned 18 points. If there are 6 problems worth 2 points each and 2 problems worth 4 points each, find the number of problems of each type Ivan answered correctly.
- NUMBERS Antonio is thinking of four numbers from 1 through 9 with a sum of 18. Find the numbers.
- 6. **MONEY** Liviana has \$2.20 in coins in her change purse. If there is a total of 15 coins, how many quarters, dimes, nickels, and pennies does she have?

Use any strategy to solve Exercises 7–14. Some strategies are shown below.





**7. ANALYZE TABLES** How much deeper is Crater Lake than Lake Superior?

Lake	Depth (ft)
Crater Lake	1,943
Lake Tahoe	1,685
Lake Chelan	1,419
Lake Superior	1,333

8. SCIENCE Mars orbits the Sun at a rate of 15 miles per second. How far does Mars travel in one day?



- **9. NUMBERS** The sum of two prime numbers is 20. Find the numbers.
- **10. PATTERNS** Draw the next figure in the pattern.



**ORDER OF OPERATIONS** Use the symbols
+, -, ×, or ÷ to make the following math sentence true. Use each symbol only once.

 $3 \blacksquare 4 \blacksquare 6 \blacksquare 1 = 18$ 

12. **SCHEDULES** The schedule for a shuttle bus is shown in the table. If the pattern continues, what time will the sixth bus arrive and depart?

Bus	Arrival Time	Departure Time
1	8:42	8:52
2	9:12	9:22
3	9:42	9:52
4	10:12	10:22

**13. ANALYZE TABLES** How many fewer students were on the 6th grade honor roll in the 3rd grading period than in the 1st grading period?

6th Grade Honor Roll Students			
1st grading period	40		
2nd grading period	37		
3rd grading period	31		

14. **MONEY** Nathaniel is saving money to buy a new graphics card for his computer that costs \$250. If he is saving \$20 a month and he already has \$160, in how many more months will he have enough money for the graphics card?

# READING to SOLVE PROBLEMS

## **Topic Sentences**

A topic sentence is a sentence that expresses the main idea in a paragraph. It is usually found near the beginning of the paragraph and is followed by supporting details. Here's the beginning of a paragraph about Mrs. Garcia's math class.

## Topic sentence

Mrs. Garcia's math class was doing research about wild horses living on public lands. They found that there are about 30,000 wild horses living in Nevada, 4,000 living in Wyoming, and 2,000 living in California.

In a word problem, the "topic sentence" is usually found near the end. It is the sentence or question that tells you what you need to find. Here's the same information, written as a word problem.

Mrs. Garcia's math class was doing research about wild horses that live on public lands. They found that there are about 30,000 wild horses living in Nevada, 4,000 living in Wyoming, and 2,000 living in California. How many more wild horses live on public lands in Nevada than in California?

Topic sentence



When you start to solve a word problem, follow these steps.

- **Step 1** Skim through the problem, looking for the "topic sentence."
- **Step 2** Go back and read the problem more carefully, looking for the supporting details you need to solve the problem.

## PRACTICE

Refer to pages 59 and 60. For each exercise below, write the "topic sentence." Do not solve the problem.

1. Exercise 29	<b>2</b> . Exercise 30
<b>3</b> . Exercise 32	4. Exercise 39
5. Exercise 40	<b>6</b> . Exercise 41







# **Algebra: Equations**

## **MAIN IDEA**

Solve equations by using mental math and the guess and check strategy.

**IN Academic Standards** 

6.2.1 Write and solve one-step linear equations and inequalities in one variable.

## **New Vocabulary**

equation equals sign solve solution

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## MINI Lab

When the amounts on each side of a scale are equal, the scale is balanced.

STEPT Place four centimeter cubes and a paper bag on one side of a scale.



- STEP 2) Place seven centimeter cubes on the other side of the scale.
- 1. Suppose the variable *x* represents the number of cubes in the bag. What equation represents this situation?
- 2. Replace the bag with centimeter cubes until the scale balances. How many centimeter cubes did you need to balance the scale?

Let *x* represent the bag. Model each sentence on a scale. Find the number of centimeter cubes needed to balance the scale.

	<b>3.</b> $x + 2 = 5$	4. $x + 5 = 7$
:	5. $x + 3 = 4$	6. $x + 6 = 6$
	• • • • • • • • • • • • • • • • • • • •	

An **equation** is a sentence that contains an **equals sign**, =. A few examples are shown below.

2 + 7 = 9 10 - 6 = 4  $14 = 2 \cdot 7$ 

Some equations contain variables.

 $2 + \mathbf{x} = 9 \qquad 4 = \mathbf{k} - 6 \qquad 15 \div \mathbf{m} = 3$ 

When you replace a variable with a value that results in a true sentence, you **solve** the equation. That value for the variable is the **solution** of the equation.







## EXAMPLES Solve an Equation Mentally

**1)** Is 3, 4, or 5 the solution of the equation a + 7 = 11?

Value of <i>a</i>	<i>a</i> + 7 <sup>2</sup> = 11	Are Both Sides Equal?
3	3 + 7 = 11 $10 \neq 11$	no
4	<b>4</b> + 7 = 11 11 = 11	yes 🖌
5	5 + 7 = 11 $12 \neq 11$	no

The solution is 4 since replacing *a* with 4 results in a true sentence.

## 2) Solve 12 = 3h mentally.

12 = 3h **THINK** 12 equals 3 times what number?  $12 = 3 \cdot 4$  You know that  $12 = 3 \cdot 4$ . 12 = 12

The solution is 4.

## CHECK Your Progress

a. Is 2, 3, or 4 the solution of the equation 4n = 16?

**b.** Solve  $24 \div w = 8$  mentally.

## Real-World EXAMPLE

**SKATING** The total cost of a pair of in-line skates and a set of kneepads is \$63. The skates cost \$45. Solve the equation 45 + k = 63 to find k, the cost of the kneepads.

Use the *guess and check* strategy.

Try 14.	
45 + k = 63	
$45 + 14 \stackrel{?}{=} 63$	
59 ≠ 63	

Try 16.  $45 + \mathbf{k} = 63$   $45 + \mathbf{16} \stackrel{?}{=} 63$  $61 \neq 63$  Try 18.  $45 + \mathbf{k} = 63$   $45 + 18 \stackrel{?}{=} 63$  $63 = 63 \checkmark$ 

So, the kneepads cost \$18.

## CHECK Your Progress

**c. ANIMALS** The difference between an ostrich's speed and a chicken's speed is 31 miles per hour. An ostrich can run at a speed of 40 miles per hour. Solve the equation 40 - c = 31 to find *c*, the speed a chicken can run.

**Real-World Link** ••• An ostrich has the

largest eye of any

land animal. It is

about 2 inches (5 centimeters) across.

Source: San Diego Zoo

## CK Your Understanding

#### Example 1 Io (p. 58)

Identify the solution of each equation from the list given. 1. 9 + w = 17; 7, 8, 9 2. d - 11 = 5; 14, 15,

- **3**. 4 = 2y; 2, 3, 4
- i; 7, 8, 92. d 11 = 5; 14, 15, 16i, 4 $4. 8 \div c = 8; 0, 1, 2$
- Example 2 (p. 58) Solve each equation mentally. 5. x + 6 = 18 6. n - 10 = 30 7. 15k = 30
- **Example 3** (p. 58) 8. **CIVICS** Mississippi and Georgia have a total of 21 electoral votes. Mississippi has 6 electoral votes. Solve the equation 6 + g = 21 to find *g*, the number of electoral votes Georgia has.

## Practice and Problem Solving

HOMEWORK HELP		
For Exercises	See Examples	
9–16	1	
17–28	2	
29, 30	3	

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Extra Practice, pp. 674, 706

Identify the solution of each equation from the list given.

<b>9</b> . <i>a</i> + 15 = 23; 6, 7, 8	<b>10</b> . 29 + <i>d</i> = 54; 24, 25, 26
<b>11.</b> $35 = 45 - n; 10, 11, 12$	<b>12</b> . 19 = <i>p</i> − 12; 29, 30, 31
<b>13</b> . 6 <i>w</i> = 30; 5, 6, 7	14. $63 = 9k; 6, 7, 8$
<b>15.</b> $36 \div s = 4; 9, 10, 11$	<b>16.</b> $x \div 7 = 3; 20, 21, 22$

## Solve each equation mentally.

<b>17</b> . <i>j</i> + 7 = 13	<b>18.</b> $m + 4 = 17$	<b>19.</b> $22 = 30 - m$
<b>20.</b> $12 = 24 - y$	<b>21</b> . 15 − <i>b</i> = 12	<b>22.</b> $25 - k = 20$
<b>23.</b> $5m = 25$	<b>24</b> . 10 <i>t</i> = 90	<b>25</b> . $22 \div y = 2$
<b>26.</b> $d \div 3 = 6$	<b>27</b> . $54 = 6b$	<b>28.</b> $24 = 12k$

- **29. BASKETBALL** One season, the Cougars won 20 games. They played a total of 25 games. Solve the equation 20 + g = 25 to find *g*, the number of games the team lost.
- **30. MONEY** Five friends earn a total of \$50 doing yard work in their neighborhood. Each friend earns the same amount. Solve the equation 5f = 50 to find *f*, the amount that each friend earns.
- **31. ANIMALS** A bottlenose dolphin is 96 inches long. There are 12 inches in 1 foot. Solve the equation 12d = 96 to find *d*, the length of the bottlenose dolphin in feet.
- **32. SCHOOL** Last year, 700 students attended Walnut Springs Middle School. This year, there are 665 students. Solve the equation 700 d = 665 to find *d*, the decrease in the number of students from last year to this year.
- **33. REASONING** If *x* is a number that satisfies 4x + 3 = 18, can *x* be equal to 3? Explain.





#### H.O.T. Problems **34. OPEN ENDED** Give an example of an equation that has a solution of 5.

**35. REASONING** Tell whether the statement below is *sometimes, always,* or never true.

Equations like a + 4 = 8 and 4 - m = 2 have exactly one solution.

## **CHALLENGE** For Exercises 36 and 37, tell whether each statement is *true* or false. Then explain your reasoning.

- **36.** In m + 8, the variable *m* can have any value.
- **37.** In m + 8 = 12, the variable *m* can have any value and be a solution.
- 38. WRITING IN MATH Create a real-world problem in which you would solve the equation a + 12 = 30.

#### ISTEP+ PRACTICE 6.2.1

- **39**. The graph shows the life expectancy of certain mammals. Which equation can be used to find the difference d between the number of years a blue whale lives and the number of years a gorilla lives?
  - A d + 35 = 80
  - **B** d 35 = 80

**C** 
$$80 + 35 = d$$

**D** 
$$d - 80 = 35$$



## **Spiral Review**

- 40. SCIENCE You have 27 bones in your hand. There are 6 more bones in your fingers than in your wrist. There are 3 fewer bones in your palm than in your wrist. How many bones are in each part of your hand? (Lesson 1-7)
- **41. CHORES** Sophia earns a weekly allowance of \$4. Define a variable. Write a function rule that relates the total allowance to the number of weeks. Find the total allowance she earns in 8 weeks. (Lesson 1-6)

Evaluate each expression if r = 2, s = 4, and t = 6. (Lesson 1-5)

**42.** 3rst + 14

**43.**  $9 \div 3 \cdot s + t$ **44.**  $4 + t \div r \cdot 4s$ 





## Explore 1-9

## Algebra Lab Writing Formulas



The number of square units needed to cover the surface of a figure is called its *area*. In this activity, you will explore how the area and side lengths of rectangles and squares are related. You will then express this relationship as an equation called a *formula*.

## ACTIVITY

STEPT) On centimeter grid paper, draw, label, and shade a rectangle with a length of 2 centimeters and a width of 3 centimeters.



(STEP 2) Count the number of squares shaded to find the area of the rectangle. Then record this information in a table like the one shown.

Rectangle	Length (cm)	Width (cm)	Area (cm <sup>2</sup> )
А	2	3	
В	2	4	
С	2	5	
D	3	4	
E	4	4	
F	5	4	

(STEP3) Repeat Steps 1 and 2 for rectangles B, C, D, E, and F, whose dimensions are shown in the table.

## **ANALYZE THE RESULTS**

- 1. Describe one or more patterns in the table.
- **2**. Describe the relationship between the area of a rectangle and its length and width in words.
- **3. MAKE A CONJECTURE** What would be the area of a rectangle with each of the following dimensions? Test your conjecture by modeling each rectangle and counting the number of shaded squares.

a. length, 2 cm; width, 8 cm b. length, 9 cm; width, 4 cm

4. WRITE A FORMULA If *A* represents the area of a rectangle, write an equation that describes the relationship between the rectangle's area *A*, length *ℓ*, and width *w*.

#### **Reading Math**

**Units** Area is measured in square units. Read *cm*<sup>2</sup> as *square centimeters*.

## ACTIVITY

2 For each step below, draw new rectangles on grid paper and find the areas. Organize the information in a table.

**STEP1** Using the original rectangles in Activity 1, double each length, but keep the same width.

**STEP2** Using the original rectangles in Activity 1, double each width, but keep the same length.

**STEP3** Using the original rectangles in Activity 1, double both the length and width.

## **ANALYZE THE RESULTS**

Compare the areas you found in each step to the original areas. Write a sentence describing how the area changed. Explain.

**5.** Step 1**6.** Step 2**7.** Step 3

ACTIVITY

- STEPT On centimeter grid paper, draw, label, and shade a square with a length of 2 centimeters.
- (STEP 2) Count the number of squares shaded to find the area of the square. Record this information in a table like the one shown.
- STEP 3 Repeat Steps 1 and 2 for squares B and C, whose dimensions are shown in the table.

	2 (	m	

Square	Side Length (cm)	Area (sq cm)
A	2	
В	3	
C	4	

## **ANALYZE THE RESULTS**

- 8. Describe a pattern in the rows of the table.
- **9. MAKE A CONJECTURE** What would be the area of a square with side lengths of 8 centimeters? Test your conjecture.
- **10. WRITE A FORMULA** If *A* represents the area of a square, write an equation that describes the relationship between the square's area *A* and side length *s*.

**Squares** A square has all four sides of equal length. So, to create the table, you only need to list the side length in one column.





**MAIN IDEA** 

Find the areas of

rectangles and squares.

6.2.2 Write and use formulas with up to

three variables to

**New Vocabulary** 

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solve problems.

<mark>area</mark> formula

**IN Academic Standards** 

# **Algebra: Area Formulas**

## MINI Lab

The rectangle at the right has an area of 20 square units. The distance around the rectangle is 5 + 4 + 5 + 4, or 18 units.

 Draw as many rectangles as you can on grid paper so that each one has an area of 20 square units. Find the distance around each one.



**2**. Which rectangle from Question 1 has the greatest distance around it? the least?

The **area** of a figure is the number of square units needed to cover a surface. You can use a formula to find the area of a rectangle. A **formula** is an equation that shows a relationship among certain quantities.

# Area of a RectangleKey ConceptWordsThe area A of a rectangle is the<br/>product of the length $\ell$ and<br/>width w.Model<br/> $\ell$ Formula $A = \ell w$



## EXAMPLE Find the Area of a Rectangle

Find the area of a rectangle with a length of 8 inches and a width of 6 inches.

- $A = \ell w$  Area of a rectangle
- $A = 8 \cdot 6$  Replace  $\ell$  with 8 and w with 6.
- A = 48 Multiply.

The area is 48 square inches.

## CHECK Your Progress

Find the area of each rectangle.

12 in. 6 in.

a.

**b**. a rectangle with a length of 10 meters and a width of 2 meters

8 in.

6 in.



In Lesson 1-3, you wrote products as powers by using exponents. The formula for the area of a square is also written with an exponent.

Area of a Square			Key Concept
Words	The area <i>A</i> of a square is the length of a side <i>s</i> squared.	Model	s
Formula	$A = s^2$		
			s









9 in.

- $A = 9^2$  Replace *s* with 9.
- A = 81 Multiply.

 $A = s^2$ 

The area is 81 square inches.

Area of a square

## CHECK Your Progress

Find the area of each square.

c. a square with side<br/>length 5 metersd. a square with side<br/>length 7 feet

## Real-World EXAMPLE

**GYMNASTICS** Use the information at the left. What is the area of a gymnastics floor routine mat?

The length of one side is 40 feet.

 $A = s^2$  Area of a square

- $A = 40^2$  Replace *s* with 40.
- A = 1,600 Multiply.

The area of a floor routine mat is 1,600 square feet.

## CHECK Your Progress

e. **SPORTS** A high school basketball court measures 84 feet long and 50 feet wide. What is the area of this court?



**Real-World Link** . . A tumbling mat for

A tumbling mat for a gymnastics floor routine is a square that measures 40 feet on each side.



5. **DISHES** A glass baking dish measures 9 inches by 13 inches. What is the area of the baking dish?

Example 3 (p. 64)

#### Practice and Problem Solving



- 12. Find the area of a rectangle with a length of 26 inches and a width of 12 inches.
- 13. What is the area of a rectangle with a length of 40 centimeters and a width of 30 centimeters?

## Find the area of each square.



17. What is the area of a square with a side length of 22 feet?







- **18. TENTS** The floor of a domed camping tent measures 7 feet by 9 feet. What is the area of the floor of the tent?
- **19. HOBBIES** Meagan and her friends are knitting small squares to join together to form a blanket. The side length of each square must be 7 inches. What is the area of each square?

## Find the area of each shaded region.



- **23. FIND THE DATA** Refer to the Data File on pages 16–19. Choose some data and write a real-world problem in which you would find the area of a square or a rectangle.
- 24. **REMODELING** The Junkins are replacing the flooring in their kitchen with ceramic tiles. They are deciding between 12-inch square tiles and 6-inch square tiles. What is the difference in the area of the two tiles they are considering?
- **25. ANIMALS** The floor spaces of two cages are shown. The square footage of Cage 1 is large enough for one guinea pig. For each additional guinea pig, the cage should be 1 square foot larger. How many guinea pigs should be kept in Cage 2?





H.O.T. Problems 26. OPEN END

**26. OPEN ENDED** Draw and label a rectangle that has an area of 48 square units.

- **27. NUMBER SENSE** Give the dimensions of two different rectangles that have the same area.
- **28. FIND THE ERROR** James and John are finding the area of the square with a side of 8 feet. Who is correct? Explain your reasoning.







- **29. CHALLENGE** Suppose opposite sides of a rectangle are increased by 5 units. Would the area of the rectangle increase by 10 square units? Use a model in your explanation.
- **30. WRITING IN MATH** Explain how to use the formula for the area of a square. Include the formula for the area of a square in your explanation.





Solve each	equation	mentally.	(Lesson 1-8)
------------	----------	-----------	--------------

**33**. x + 4 = 12

**34.** 9 - m = 5

**35**. k - 8 = 20

Copy and complete each function table. (Lesson 1-6)

36.	Input ( <i>x</i> )	Output $(5 + x)$
	0	
	3	
	5	

37.	Input (x)	Output ( $x \div 2$ )
	2	
	4	
	8	

- **38**. What is the value of  $n^3 + 5n$  if n = 2? (Lesson 1-5)
- **39. SCIENCE** The Milky Way galaxy is about 10<sup>5</sup> light years wide. What is the value of 10<sup>5</sup>? (Lesson 1-3)



# Study Guide and Review

STUDY TO CO
 Vocabulary Review

# FOLDA BLES

Be sure the following Big Ideas are noted in your Foldable.



## **BIG Ideas**

## Prime and Composite Numbers (Lesson 1-2)

- A prime number has exactly two factors, 1 and the number itself.
- A composite number is a number greater than 1 with more than two factors.
- 1 has only one factor and is neither prime nor composite. 0 has an infinite number of factors and is neither prime nor composite.

## Order of Operations (Lesson 1-4)

- Step 1 Simplify the expression inside grouping symbols, like parentheses.
- Step 2 Find the value of all powers.
- Step 3 Multiply and divide in order from left to right.
- Step 4 Add and subtract in order from left to right.

## Area Formulas (Lesson 1-9)

• The area *A* of a rectangle is the product of the length  $\ell$  and width *w*.



• The area *A* of a square is the length of a side *s* squared.



## **Key Vocabulary**

algebra (p. 42)	function (p. 49)
algebraic expression (p. 42)	function rule (p. 49)
<mark>area</mark> (p. 63)	function table (p. 49)
<mark>base</mark> (p. 32)	numerical expression (p. 37)
composite number (p. 28)	order of operations (p. 37)
<mark>cubed</mark> (p. 33)	<mark>power</mark> (p. 33)
defining the variable (p. 50)	prime factorization (p. 29)
<mark>equals sign</mark> (p. 57)	prime number (p. 28)
equation (p. 57)	solution (p. 57)
evaluate (p. 42)	<mark>solve</mark> (p. 57)
<mark>exponent</mark> (p. 32)	<mark>squared</mark> (p. 33)
factor (p. 28)	variable (p. 42)
<mark>formula</mark> (p. 63)	

## Vocabulary Check

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

- 1. A <u>formula</u> is used to find the area of a rectangle.
- When two or more numbers are multiplied, each number is called a <u>factor</u>.
- **3**. The <u>base</u> of a figure is the number of square units needed to cover a surface.
- 4. A <u>function</u> represents an unknown value.
- 5. A <u>variable</u> is a relationship that assigns exactly one output value to one input value.

## **Lesson-by-Lesson Review**

## A Plan for Problem Solving (pp. 24–27)

Use the four-step plan to solve each problem.

- 6. **MOVIES** The times that a new movie is showing are 9:30 A.M., 11:12 A.M., 12:54 P.M., and 2:36 P.M. If the pattern continues, what are the next three show times?
- 7. FUND-RAISING Keith's goal is to collect \$145 for a school trip. So far, he has collected \$20 each from two people and \$10 each from six people. How far away is he from his goal?

**Example 1** Juanita works after school at an ice cream shop. Her hourly wage is \$7. If Juanita works 25 hours every week, how much does she earn?

Understand	You need to find the total
	amount she earned.
Plan	Multiply \$7 by 25.
Solve	$7 \times 25 = 175$
	So, Juanita earned \$175.
Check	Since $175 \div 7 = 25$ , the
	answer makes sense.



1-1

P.1.1

## Prime Factors (pp. 28–31)

Tell whether each number is *prime*, *composite*, or *neither*.

**8**. 44 **9**. 67

Find the prime factorization of each number.

**10.** 42 **11.** 75 **12.** 96

13. **CODES** Cryptography uses prime numbers to encode secure bank account information. Suppose Suki's bank account was encoded with the number 273. What are the prime number factors of this code?

## **Example 2** Find the prime factorization of 18.

Make a factor tree.



Choose any two factors of 18.

Write the number to be factored.

Continue to factor any number that is not prime until you have a row of prime numbers.

The prime factorization of 18 is  $2 \times 3 \times 3$ .

**1-3** 

## Powers and Exponents (pp. 32–36)

Write each product using an exponent. Then find the value of the power.

- $14. 5 \times 5 \times 5 \times 5$ 
  - **15**. 12 × 12 × 12
- ANIMALS The average brain weight in grams for a walrus is 2<sup>10</sup>. Find this value.

**Example 3** Write  $4 \times 4 \times 4 \times 4 \times 4 \times 4$  using an exponent. Then find the value of the power.

The base is 4. Since 4 is a factor 6 times, the exponent is 6.

 $4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^6$  or 4,096

**Study Guide and Review** 



WAPT

## Order of Operations (pp. 37–40)

Find the value of each expression.

- **17.**  $4 \times 6 + 2 \times 3$
- **18.**  $8 + 3^3 \times 4$
- **19.**  $10 + 15 \div 5 6$
- **20.**  $11^2 6 + 3 \times 15$
- 21. **TRAVEL** On a family trip to The Motorcycle Museum, Maria counted 3 groups of motorcycles, each with 5 motorcycles, and an additional 7 lone motorcycles. Write an expression for the number of motorcycles Maria saw. Then find the number of motorcycles she saw.

## **Example 4** Find the value of $28 \div 2 - 1 \times 5$ . $28 \div 2 - 1 \times 5$ $= 14 - 1 \times 5$ Divide 28 by 2. = 14 - 5 Multiply 1 and 5. = 9 Subtract 5 from 14.

The value of  $28 \div 2 - 1 \times 5$  is 9.



## Algebra: Variables and Expressions (pp. 42–46)

Evaluate each expression if a = 18 and b = 6.

**22.**  $a \times b$  **23.**  $a^2 \div b$ **24.**  $3b^2 + a$  **25.** 2a - 10

Evaluate each expression if x = 6, y = 8, and z = 12.

- **26.** 2x + 4y
- **27.**  $3z^2 + 4x$

**28**. 
$$z \div 3 + xy$$

**29. HOME REPAIR** Joe will tile a square kitchen floor with square ceramic tile. He knows the number of tiles needed is equal to  $a^2 \div b^2$ , where *a* is the floor length in inches and *b* is the length of the tile in inches. If a = 96 and b = 8, how many tiles are needed?

**Example 5** Evaluate  $9 - k^3$  if k = 2.  $9 - k^3 = 9 - 2^3$  Replace *k* with 2. = 9 - 8  $2^3 = 8$ = 1 Subtract 8 from 9.

**Example 6** Evaluate 10 + mn if m = 3 and n = 5.

 $10 + mn = 10 + (3)(5) \quad m = 3 \text{ and } n = 5$ = 10 + 15 Multiply 3 and 5. = 25 Add 10 and 15.



## Algebra: Functions (pp. 49–53)

Copy and complete each function table.

30.	Input ( <i>x</i> )	Output $(x - 1)$
	1	
	6	
	8	

31.	Input ( <i>x</i> )	Output (3 <i>x</i> )
	0	
	5	
	7	

32.	Input ( <i>x</i> )	Output ( $x \div 2$ )
	0	
	4	
	10	

Find the rule for each function table.

21

33.	X	
	2	8
	7	13
	12	18

54.	X	
	0	0
	3	6
	5	10

- **35. TRAVEL** Tina drove 60 miles per hour to Tucson. Define a variable. Write a function rule that relates the number of miles traveled to the hours driven.
- **36. AGES** A boy is 5 years older than his sister. Define a variable. Write a function rule that relates the age of the boy to the age of his sister.

## **Example 7** Copy and complete the function table.

Input (x)	Output $(x + 5)$
0	
4	
9	

The function rule is x + 5. Add 5 to each input.

Input ( <i>x</i> )	Output $(x + 5)$
0	5
4	9
9	14

## **Example 8** Find a rule for the function table.

X	
6	2
12	4
15	5

Study the relationship between each input and output. Divide each input by 3 to find the output.

So, the function rule is  $x \div 3$ .



## **Study Guide and Review**



## PSI: Guess and Check (pp. 54–55)

Solve. Use the *guess and check* strategy.

- **37. PRODUCTION** A company makes toy cars. It sells red cars for \$2 each and black cars for \$3 each. If the company sold 44 cars total and made \$105, how many red cars were sold?
- **38. NUMBERS** The sum of two numbers is 22 and their product is 117. Find the numbers.
- **39. FISHING** On a fishing trip with his friends, Alex caught 3 more catfish than he did trout. If the total number of catfish and trout was 19, how many catfish did he catch?

**Example 9** Owen is 8 inches taller than his sister, Lisa. If the sum of their heights is 124 inches, how tall is Owen?

Make a guess. Check to see if it is correct. Adjust the guess until it is correct.

Owen's Height	Lisa's Height	Sum of Heights	
60 inches	52 inches	112 inches	too low
68 inches	60 inches	128 inches	too high
66 inches	58 inches	124 inches	
So, Owen	is 66 inche	s tall.	



## Algebra: Equations (pp. 57–60)

#### Solve each equation mentally.

<b>40</b> . $p + 2 = 9$	<b>41</b> . $20 + y = 25$
<b>42</b> . $40 = 15 + m$	<b>43</b> . $16 - n = 10$
<b>44.</b> $27 = x - 3$	<b>45</b> . $17 = 25 - h$

**46. AGE** The equation 18 + p = 34 represents the sum of Pedro's and Eva's ages, where *p* represents Pedro's age. How old is Pedro?

## **Example 10** Solve x + 9 = 13 mentally.

x + 9 = 13 What number plus 9 is 13? 4 + 9 = 13 You know that 4 + 9 is 13. x = 4 The solution is 4.



## Algebra: Area Formulas (pp. 63–67)

**47**. Find the area of the rectangle below.

13 cm

2 cm

**48. PAINTINGS** Find the area of a painting that measures 4 feet by 4 feet.









1. **MULTIPLE CHOICE** Justin earned \$308 by mowing lawns and raking leaves for a total of 43 hours. He raked leaves for 18 hours and earned \$108. Arrange the steps below in a correct order to find how much he earned per hour mowing lawns.

Step P: Find the difference between \$308 and the amount Justin earned raking leaves.

- Step Q: Find the quotient of \$200 and the number of hours Justin spent mowing lawns.
- Step R: Find the number of hours Justin spent mowing lawns.

Which list shows the steps in the correct order?

- **A** P, Q, R
- **B** R, O, P
- **C** O, R, P **D** R, P, Q

Tell whether each number is *prime*, *composite*, or neither.

2. 57 **3**. 1 4. 31

- 5. Find the prime factorization of 68.
- 6. **BIRTHDAYS** Miranda told 3 friends that it was her birthday. Each of those 3 friends told 3 other students. By noon, 3<sup>5</sup> students knew it was Miranda's birthday. Write this number as a product of the same factor. Then find the value.

Find the value of each expression. 8.  $72 \div 2^3 - 4 \times 2$ 7.  $12 - 3 \times 2 + 15$ 

Evaluate each expression if a = 4 and b = 3.

**10**. 27 ÷ *b* 11.  $a^3 - 2b$ **9**. *a* + 12

12. MULTIPLE CHOICE Latisha and Raquel ordered two beverages for \$1.50 each, two dinners for \$12.99 each, and a dessert for \$3.50. Which of the following expressions can be used to find the amount each should pay, not including tax?

**F**  $1.50 + 2 \times 12.99 + 3.50 \div 2$ 

- **G**  $(2 \times 1.50 + 2 \times 12.99 + 3.50) \div 2$
- **H**  $2 \times (1.50 + 12.99 + 3.50)$ 
  - J  $(2 \times 1.50 + 12.99) + 3.50 \div 2$

## Find the rule for each function table.

3	8
7	12
11	16

13

•	X	
	0	0
	8	1
	16	2

- 15. NUTRITION A medium potato has 26 grams of carbohydrates. Define a variable. Write a function rule that relates the amount of carbohydrates to the number of potatoes.
- 16. **MONEY** Diego has \$1.30 in quarters, dimes, and nickels. He has the same amount of nickels as quarters, and one more dime than nickels. How many of each coin does he have?

## Solve each equation mentally.

17.	d + 9 = 14	<b>18.</b> $56 = 7k$	
19.	Find the area of the rectangle.	17 ft	8 f

20. **RUGS** Benito has a square rug in his dining room. The length of each side of the rug is 42 inches. Find the area of the rug.



# **JISTEP+** Practice

Test Practice

## PART 1 Multiple Choice

Read each question. Then fill in the correct answer on the answer sheet provided by your teacher or on a sheet of paper.

- At a large middle school, there are 18 sixth-grade homerooms and approximately 22 students in each homeroom. About how many sixth-grade students attend the middle school?
  - **A** 250
  - **B** 325
  - **C** 400
  - **D** 650
- 2. Samantha drives 585 miles to reach her vacation spot. Her total drive time is nine hours. How would you find Samantha's average speed for the trip?
  - **F** Add Samantha's total miles driven to her total drive time.
  - **G** Subtract Samantha's total drive time from the total miles driven.
  - **H** Multiply Samantha's total miles driven by the total drive time.
  - J Divide Samantha's total miles driven by her total drive time.
- **3**. The cost of renting roller blades is \$4 plus \$3.50 for each additional hour that the roller blades are rented. Which equation can be used to find *c*, the cost in dollars of the rental for *h* hours?
  - **A** c = 4h + 3.5

**B** 
$$c = 3.5 - 4h$$

**C** 
$$c = 3.5(h + 4)$$

**D** 
$$c = 3.5h + 4$$

 Mr. Weiss started painting the kitchen at 8:45 A.M. and finished painting at 12:00 P.M. About how many hours elapsed between the time he started painting and the time he finished painting the kitchen?

F	2 h	Η	4 h
G	3 h	J	5 h

- 5. Which is the prime factorization of 360?
  A 3<sup>3</sup> 5<sup>2</sup>
  - **B** 2<sup>7</sup>
  - **C**  $2^3 \cdot 3^2 \cdot 5$
  - **D**  $3^2 \cdot 5 \cdot 7^2$
- **6**. Jeremy was asked to find two integers that have a difference of 3 and a sum of 71. He said that the integers were 39 and 36. Why was Jeremy's answer incorrect?
  - **F** The difference between 39 and 36 is not 3.
  - **G** The difference between 39 and 36 is 3.
  - H The sum of 39 and 36 is not 71.
  - J The sum of 39 and 36 is 71.
- Amanda planted a square garden. The length of each side of the garden was 8 feet. Find the area of the garden.
  - $\mathbf{A}$  16 ft<sup>2</sup>
  - **B** 32 ft<sup>2</sup>
  - $C 64 ft^2$
  - $\mathbf{D} 80 \ \mathrm{ft}^2$

## TEST-TAKING TIP

**Question 7** Review any terms and formulas that you have learned before you take the test.



8. The table shows Molly's age and Max's age over 4 consecutive years.

Molly's Age, x (years)	Max's Age, y (years)
2	5
3	6
4	7
5	8

Which expression best represents Max's age in terms of Molly's age?

- **F** y + 3 **H** x + 3**G** 3x **J** 3y
- 9. At his job, Jack uses about 3 boxes of computer paper every 5 working days. About how many boxes of computer paper does Jack use in 36 working days?

A	8	C	21
B	15	D	108

**10.** A sub shop is keeping track of the number of meatball subs sold each day.

Day	Number of Meatball Subs Sold
Monday	40
Tuesday	25
Wednesday	30
Thursday	45
Friday	65
Saturday	70
Sunday	50

About how many subs were sold during that week?

J 350 subs

- **F** 150 subs **H** 250 subs
- **G** 200 subs

## PART 2 Short Response/Grid In

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

- **11.** What is the value of  $45 \div (7 + 2) 1$ ?
- 12. Lynette is painting a 15-foot by 10-foot rectangular wall that has a 9-foot by 5-foot rectangular window at its center. How many square feet of wall will she paint?



## PART 3 Extended Response

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

**13**. The following figures are made of toothpicks.



- a. Make a table that shows the number of toothpicks needed for the first 5 figures.
- **b**. Write an expression to find the number of toothpicks for any figure. Explain your reasoning.

If You Missed Question		1	2	3	4	5	6	7	8	9	10	11	12	13		
Go to Lesson		1-1	1-1	1-5	1-1	1-3	1-1	1-9	1-6	1-1	1-1	1-4	1-9	1-1		
		IN Academic Standards		P.1.1	P.1.1	6.2.3	P.1.1	7.1.3	P.1.1	6.2.2	6.2.5	P.1.1	P.1.1	6.2.3	6.2.2	P.1.1