Name _____ Date _____ Class_____

LESSON 9-1

Exponents

Practice and Problem Solving: A/B

Write each expression in exponential form and find its value.

1. $2 \times 2 \times 2 \times 2$

_____

2. $3 \times 3 \times 3$

_____

3. $\frac{3}{5} \times \frac{3}{5}$

_____

4. 10×10

_____

5. $\frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} \times \frac{1}{6}$

_____

6. $0.5 \times 0.5 \times 0.5$

_____

Find each value.

7. $(1.2)^3$

_____

8. $\left(\frac{1}{4}\right)^4$

_____

9. $(2)^6$

_____

10. 2^6

_____

Solve.

11. The volume of a cubic box is 10^6 cubic millimeters. Write the volume of the box in standard form.

_____

How long is each side of the box? (*Hint*: The length, width, and height of a cube are equal.)

_____

12. The voltage in an electrical circuit is multiplied by itself each time it is reduced. The voltage is $\frac{27}{125}$ of a volt and it has been reduced three times. Write the voltage in exponential form. _____

What was the original voltage in the circuit? _____

Compare using >, <, or =.

13. $\left(\frac{1}{3}\right)^4$ _____ $\left(\frac{1}{3}\right)^0$

14. $(1)^5$ _____ 1^5

15. 5^0 _____ -5^0

16. Use exponents to write 81 three different ways.

81 = _____; 81 = _____; 81 = _____

Name _____ Date _____ Class _____

LESSON 9-1

Exponents

Practice and Problem Solving: C

Use the definitions of exponents to show that each statement is true.

1. $3^5 = (3)^5$

2. $\left(\frac{2}{3}\right)^3 < \left(\frac{2}{3}\right)^1$

3. $(0.72)^7 > (-7.2)^7$

_____ _____ _____

4. A halogen-lighting manufacturer packs 64 halogen lamps in a cube-shaped container. The manufacturer has been asked by his distributors to package the lamps in a smaller container that holds 8 lamps.

   a. Write the number of lamps in the larger package in exponential form. _____

   b. Use the answer to part a. to indicate how many lamps wide, deep, and high the larger shipping container is.

   _____

   c. Write the number of lamps in the smaller package in exponential form. _____

   d. How many of the smaller cubic packages fit into the larger cubic package? Explain how you get your answer.

   _____

Simplify each exponential number. Then, multiply the numbers.

5. $\left(\frac{2}{3}\right)^4 =$ _____

   $\left(\frac{3}{2}\right)^4 =$ _____

   $\left(\frac{2}{3}\right)^4 \times \left(\frac{3}{2}\right)^4 =$ _____

6. $(0.5)^3 =$ _____ $(2)^3 =$ _____

   $(0.5)^3 \times (2)^3 =$ _____

Use the answers to the third parts of Exercises 5 and 6 to supply the missing number in each problem.

7. $\left(\frac{7}{5}\right)^2 \times$ _____ $= 1$

8. $(4)^3 \times$ _____ $= 1$

9. $(0.3)^6 \times$ _____ $= 1$

Name _____ Date _____ Class _____

LESSON 9-1

Exponents

Practice and Problem Solving: D

Name the *base* and *exponent*. The first one is done for you.

1. 2^7

   Base: **2**

   Exponent: **7**

2. $\left(\frac{5}{6}\right)^4$

   Base: _____

   Exponent: _____

3. $(5)^{10}$

   Base: _____

   Exponent: _____

Write using exponents. The first one is done for you.

4. $10{,}000 = \mathbf{10 \times 10 \times 10 \times 10} =$ **10^4**

5. $\frac{8}{27} =$ ___ × ___ × ___ = _____

6. 64 = ___ × ___ × ___ = _____

Write as repeated multiplication. The first one is done for you.

7. $(2)^2 =$ **(2) × (2)**

8. $(0.25)^3 =$ _____

9. $\left(\frac{1}{9}\right)^3 =$ _____

Solve. The first one is done for you.

10. The temperature inside the glazing oven is about 1,000 degrees Fahrenheit. Write 1,000 using exponents.

    Count the number of places from the decimal point on the right to the comma between the "1" and the "0" next to it. That number of places is the exponent. The base is 10. The answer is 1,000 = 10^3.

11. A sports memorabilia collector has 3^3 1980 baseball cards and 4^3 1990 football cards. Write the number of baseball cards and football cards in standard form.

    _____

12. A long-distance runner ran 4 × 4 × 4 × 4 × 4 × 4 miles last year. How many miles is this?

    _____

Name _____ Date _____ Class_____

LESSON 9-1

Exponents

Reteach

You can write a number in exponential form to show repeated multiplication. A number written in exponential form has a **base** and an **exponent**. The exponent tells you how many times a number, the base, is used as a factor.

8^4 ← exponent

↓

base

Write the expression in exponential form.

$(0.7) \times (0.7) \times (0.7) \times (0.7)$

0.7 is used as a factor 4 times.

$(0.7) \times (0.7) \times (0.7) \times (0.7) = (0.7)^4$

Write each expression in exponential form.

1. $\frac{1}{20} \times \frac{1}{20} \times \frac{1}{20} \times \frac{1}{20}$ _____

2. 8×8 _____

3. $7.5 \times 7.5 \times 7.5$ _____

4. (0.4) _____

You can find the value of expressions in exponential form.
Find the value.
5^6

Step 1 Write the expression as repeated multiplication.
$5 \times 5 \times 5 \times 5 \times 5 \times 5$

Step 2 Multiply.
$5 \times 5 \times 5 \times 5 \times 5 \times 5 = 15{,}625$

$5^6 = 15{,}625$

Simplify.

5. $\left(\frac{1}{2}\right)^3$ _____

6. $(1.2)^5$ _____

7. 3^6 _____

8. $\left(\frac{4}{3}\right)^2$ _____

Name _____ Date _____ Class _____

LESSON 9-1

Exponents

Reading Strategies: Synthesize Information

Exponents are an efficient way to write repeated multiplication.

Read 2^4 ⟶ *2 to the fourth power*

2^4 means **2 is a factor 4 times**, or

$2 \times 2 \times 2 \times 2$

Read $2^4 = 16$ ⟶ *2 to the fourth power equals 16.*

Exponent	Meaning	Value
10^3 *10 to the third power*	10 is a factor 3 times: $10 \times 10 \times 10$	$10^3 = 1{,}000$
6^5 *6 to the fifth power*	6 is a factor 5 times: $6 \times 6 \times 6 \times 6 \times 6$	$6^5 = 7{,}776$

Answer each question.

1. Write in words how you would read $(2)^5$.

_____

2. What does $(2)^5$ mean?

_____

3. What is the value of $(2)^5$?

_____

4. Write in words how you would read $\left(\frac{3}{5}\right)^4$.

_____

5. Write $\left(\frac{3}{5}\right)^4$ as repeated multiplication.

_____

6. Is the value of $\left(\frac{3}{5}\right)^4$ equal to $\frac{3}{5}$ times four? Explain your answer.

_____

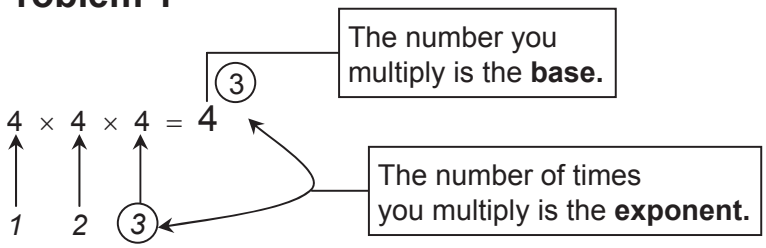
Name _____ Date _____ Class _____

LESSON 9-1

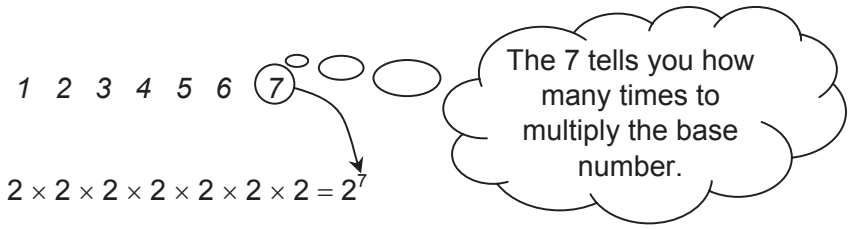
Exponents

Success for English Learners

Problem 1



Problem 2



1. In Problem 2, what is the base? _____

2. In Problem 2, what is the exponent? _____

3. How do you read the number in Problem 1?

   _____

4. How do you read the number in Problem 2?

   _____

5. a. Write the number 7 raised to the third power. _____

   b. What is the exponent? _____

   c. What is the base? _____

6. a. Write the number 5 raised to the sixth power. _____

   b. What number do you multiply? _____

   c. How many times do you multiply it? _____

Name _____ Date _____ Class _____

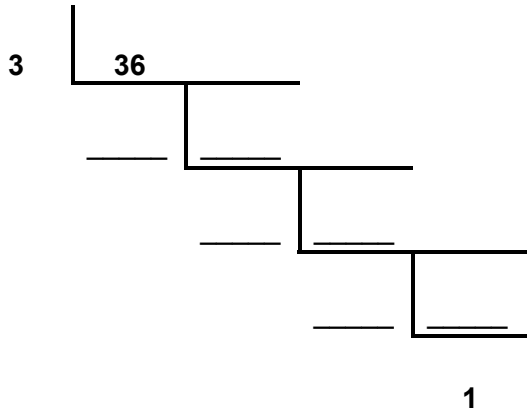
LESSON 9-2

Prime Factorization

Practice and Problem Solving: A/B

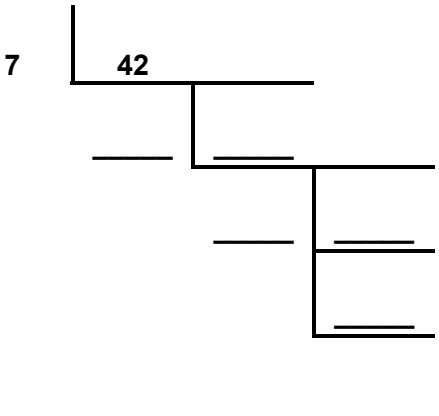
Fill in the missing information. Add more "steps" to the ladder diagram and more "branches" to the tree diagram, if needed. Then, write the prime factorization of each number.

1.



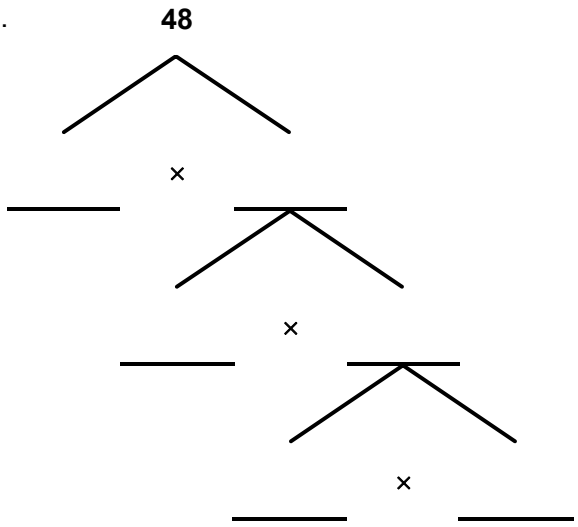
_____

2.



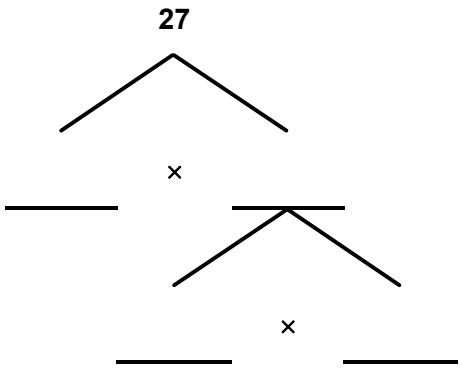
_____

3.



_____

4.



_____

Write the prime factorizations.

5. 44 _____

6. 125 _____

7. 85 _____

8. 39 _____

Name _____ Date _____ Class_____

LESSON 9-2

Prime Factorization

Practice and Problem Solving: C

If 9 is divisible by 3 and 14 is divisible by 2, then 9 × 14 is divisible by 3 × 2. Use this rule to complete Exercises 1–3. Simplify the numbers to prove the result.

1. Twenty-one is divisible by 3. Fifteen is divisible by 5. Therefore,

   _____ times _____ is divisible by _____ times _____

   _____

2. Eighteen is divisible by 2. Twelve is divisible by 3. Therefore,

   _____ times _____ is divisible by _____ times _____

   _____

3. Ten is divisible by 5. Fourteen is divisible by 7. Therefore,

   _____ times _____ is divisible by _____ times _____

   _____

Unit fractions **are fractions of the form $\frac{1}{n}$. Give the prime factorization of each unit fraction into fractions that cannot be reduced.**

4. $\frac{1}{100}$

   _____

5. $\frac{1}{24}$

   _____

Any integer *n* that is greater than 1 is either prime or a product of primes. List the different prime numbers that make up the prime factorization of these composite numbers.

6. 24

   _____

7. 105

   _____

8. 924

   _____

Solve.

9. There are 126 different combinations of soups, salads, and sandwiches available at a café. If there are more choices of sandwiches than choices of salads and fewer choices of soups than salads, how many of each type of food is available at the café?

   _____

Name _____ Date _____ Class _____

LESSON 9-2

Prime Factorization

Practice and Problem Solving: D

List all of the factors of each number. Circle the prime factors. The first one is done for you.

1. 6

   1; (2); (3); 6

2. 9

   _____

3. 10

   _____

4. 12

   _____

5. 21

   _____

6. 31

   _____

Write the prime factorization of each number. The first one is done for you.

7. 9

   3^2

8. 25

   _____

9. 8

   _____

10. 14

    _____

11. 12

    _____

12. 15

    _____

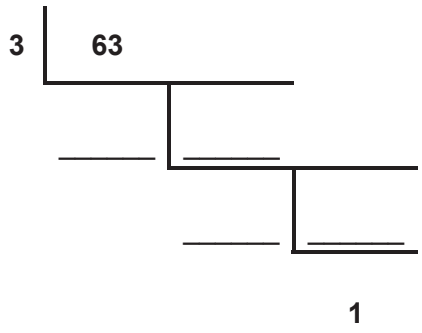
13. There are 12 chairs in the meeting hall and an odd number of tables. Each table has the same number of chairs. How many tables are there?

    _____

14. What are two different ways that 9 can be written as a product of two numbers?

    _____

15. Find the prime factorization of 63 with the factor ladder. The first step is done for you.



Prime factorization: _____

Name _____ Date _____ Class _____

LESSON 9-2

Prime Factorization

Reteach

Factors of a product are the numbers that are multiplied to give that product.

A factor is also a whole number that divides the product with no remainder.

To find all of the factors of 32, make a list of multiplication facts.

$1 \bullet 32 = 32$

$2 \bullet 16 = 32$

$4 \bullet 8 = 32$

The factors of 32 are 1, 2, 4, 8, 16, and 32.

Write multiplication facts to find the factors of each number.

1. 28

_____

2. 15

_____

3. 36

_____

4. 29

_____

A number written as the product of prime factors is called the **prime factorization** of the number.

To write the prime factorization of 32, first write it as the product of two numbers. Then, rewrite each factor as the product of two numbers until all of the factors are prime numbers.

$32 = 2 \bullet \mathbf{16}$ (Write 32 as the product of 2 numbers.)

$= 2 \bullet \mathbf{4} \bullet \mathbf{4}$ (Rewrite 16 as the product of 2 numbers.)

$\downarrow \quad \downarrow$

$= 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2$ (Rewrite the 4's as the product 2 prime numbers.)

So, the prime factorization of 32 is $2 \bullet 2 \bullet 2 \bullet 2 \bullet 2$ or 2^5.

Find the prime factorization of each number.

5. 28

_____

6. 45

_____

7. 50

_____

8. 72

_____

Name _____ Date _____ Class_____

LESSON 9-2

Prime Factorization

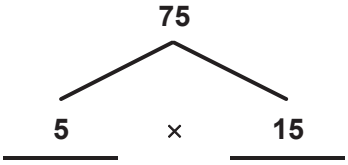
Reading Strategies: Use a Graphic Organizer

A graphic organizer can help you "see" how to factor numbers. One of the organizers used in this lesson is the **factor tree**.

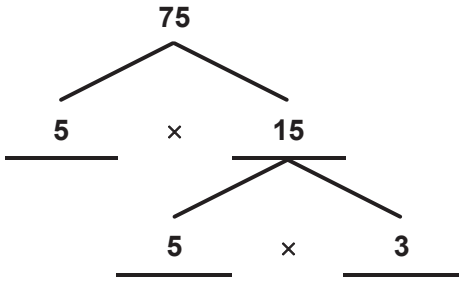
Example

Factor 75 using a factor tree.

Start by writing 75 at the top of the tree. Then, think of a prime number that divides 75 evenly.



Then, think of a prime number that divides 15 evenly. Add two new "branches" to the tree below 15 as shown.



Continue adding "branches" as needed. When the numbers on the last "branch" of the tree are prime numbers, write the prime factorization of the number: $75 = 3 \times 5 \times 5 = 3 \times 5^2$.

Draw a factor tree for each number on the back of this page or on another sheet of paper. Then, write the prime factorization of the number.

1. 360 =

2. 378 =

Name _____ Date _____ Class _____

LESSON 9-2

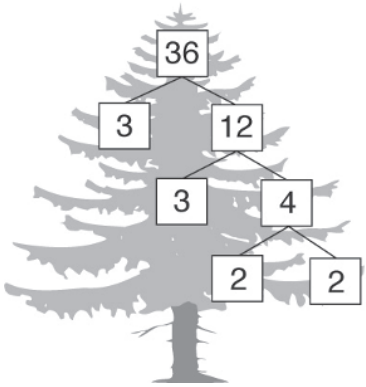
Prime Factorization

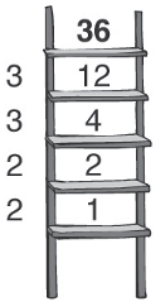
Success for English Learners

Problem 1

What is the prime factorization of 36?

Factor Tree ← Use → Ladder Diagram

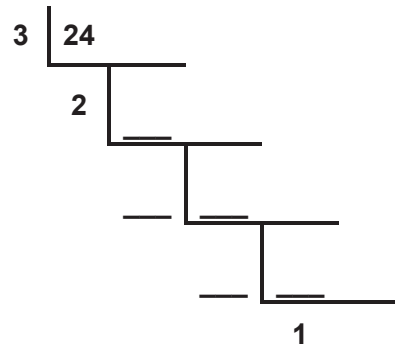




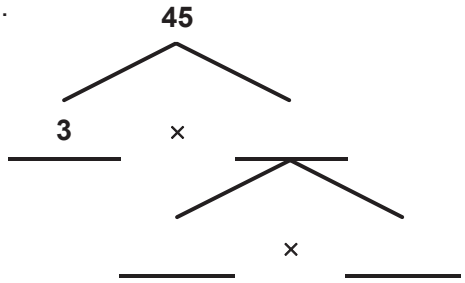
$36 = 3 \bullet 3 \bullet 2 \bullet 2$ or $3^2 \bullet 2^2$

Complete each diagram. Then, write the prime factorization.

1.



2.



_____ _____

Name _____ Date _____ Class _____

LESSON 9-3

Order of Operations

Practice and Problem Solving: A/B

Name the operation you should perform first.

1. $4 \times 6 - 3$ _____
2. $1 + 8 \div 2$ _____
3. $(2 + 5) - 4^2$ _____
4. $7 \div 7^3 \times 7$ _____
5. $8^2 \div (8 - 4)^2$ _____
6. $-4 + 3^3 \div 5$ _____

Match each expression to its value.

Expression	Value
7. $7 + 8 - 2$	A. 9
8. $9 + (12 - 10)$	B. 40
9. $(20 - 15) \times 2$	C. 12
10. $10 \div 5 + 7$	D. 14
11. $6 + 2 \times 3$	E. 16
12. $(2 \times 4) + 8$	F. 11
13. $14 + 2 \times 0$	G. 13
14. $(5 - 1) \times 10$	H. 10

15. A sixth-grade student bought three cans of tennis balls for $4 each. Sales tax for all three cans was $.95. Write an expression to show the total amount the student paid.

_____

16. The middle-school camera club sold 240 tulip bulbs and 360 daffodil bulbs. Students divided the bulbs into 100 bags to sell at the school fair. Write an expression to show how many bulbs went into each of the 100 bags if students put the same number of each kind of bulb in each bag.

_____

Name _____ Date _____ Class _____

LESSON 9-3

Order of Operations

Practice and Problem Solving: C

Insert +, –, ×, and/or ÷ signs to make each statement true.

1. $1 \bigcirc 2 < 3 \bigcirc 4$
2. $(5 \bigcirc 6) + 7 = 6 \bigcirc (5 - 4)$
3. $8 + 9 \bigcirc 10 > (6 \times 7) \bigcirc 5$

Evaluate each expression.

4. $(5 + 0) \div 4$

_____

5. $5 + (0 \div 4)$

_____

6. $7 \div (6 + 0)$

_____

7. $(7 + 6) \div 0$

_____

8. $(1 \times 2) \div 3$

_____

9. $1 \div (2 \times 3)$

_____

Write the consecutive integers that make the statements true.

10. _____ $< (15 \div 7) \times 4 <$ _____

11. _____ $> 7 \times (6 \div 4)^2 >$ _____

The Pythagorean Theorem states that sum of the squares of the two legs of a right triangle, *a* and *b*, is equal to the square of the hypotenuse, *c*, of the right triangle: $a^2 + b^2 = c^2$. Use the theorem to complete Exercises 12–14.

12. One leg of a right triangle is 4 less than the other leg. The square of the hypotenuse of the right triangle is 80. How long are the legs of the right triangle? Show your work.

_____

_____

13. Find the square of the leg *b* of this right triangle: $a = 2b$, $c = 10$

_____

14. Find the square of the hypotenuse of a right triangle with *a* and *b* related by the statement $a = b - 5$.

_____

Name _____ Date _____ Class _____

LESSON 9-3

Order of Operations

Practice and Problem Solving: D

Name the operation you should perform first. The first one is done for you.

1. $5 + 6 \times 2$ **Multiplication**

2. $18 \div 3 - 1$ _____

3. $3^2 + 6$ _____

4. $(15 + 38) \times 6$ _____

Order of Operations
1. Parentheses
2. Exponents
3. Multiplication
4. Division
5. Addition
6. Subtraction

Match each expression to its value. The first one is done for you.

	Expression	Value
E	5. $7 + 8 - 2$	A. 9
_____	6. $9 + (12 - 10)$	B. 12
_____	7. $(20 - 15) \times 2$	C. 16
_____	8. $10 \div 5 + 7$	D. 11
_____	9. $6 + 2 \times 3$	E. 13
_____	10. $(2 \times 4) + 8$	F. 10

11. a. Sam bought two CDs for $13 each. Sales tax for both CDs was $3. Write an expression to show how much Sam paid in all.

_____

b. How much did Sam pay?

_____

12. Write an expression using multiplication and addition with a sum of 16.

_____

13. Write an expression using division and subtraction with a difference of 3.

_____

Name _____ Date _____ Class _____

LESSON 9-3

Order of Operations

Reteach

A mathematical phrase that includes only numbers and operations is called a *numerical expression*.

$9 + 8 \times 3 \div 6$ is a numerical expression.

When you evaluate a numerical expression, you find its value.

You can use the order of operations to evaluate a numerical expression.

Order of operations:

1. Do all operations within *parentheses*.
2. Find the values of numbers with *exponents*.
3. *Multiply* and *divide* in order from left to right.
4. *Add* and *subtract* in order from left to right.

Evaluate the expression.

$60 \div (7 + 3) + 3^2$

$60 \div 10 + 3^2$	Do all operations within parentheses.
$60 \div 10 + 9$	Find the values of numbers with exponents.
$6 + 9$	Multiply and divide in order from left to right.
15	Add and subtract in order from left to right.

Simplify each numerical expression.

1. $7 \times (12 + 8) - 6$

   $7 \times$ _____ $- 6$

   _____ $- 6$

   _____

2. $10 \times (12 + 34) + 3$

   $10 \times$ _____ $+ 3$

   _____ $+ 3$

   _____

3. $10 + (6 \times 5) - 7$

   $10 +$ _____ $- 7$

   _____ $- 7$

   _____

4. $2^3 + (10 - 4)$

   _____

5. $7 + 3 \times (8 + 5)$

   _____

6. $36 \div 4 + 11 \times 8$

   _____

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

   _____

8. $3 \times (12 \div 4) - 2^2$

   _____

9. $(3^3 + 10) - 2$

   _____

Solve.

10. Write and evaluate your own numerical expression. Use parentheses, exponents, and at least two operations.

    _____

Name _____ Date _____ Class_____

LESSON 9-3

Order of Operations

Reading Strategies: Use a Memory Aid

A memory aid can help you recall the order of operations in simplifying a numerical expression. Just remember the first letter of each operation.

P → **Parentheses**

E → **Exponents**

M → **Multiply**

D → **Divide**

A → **Add**

S → **Subtract**

The six letters form the "word" **PEMDAS**, pronounced "Pem-das". "Pem" rhymes with "Tim", and "das" sounds like "does."

Another way to recall the order of operation is in a sentence.

"Please Excuse My Dear Aunt Sally."

You can come up with your own sentence using the first letters of the operations, too.

Fill in the steps in each simplification.

1. $4 + (9 \div 3)^2 \times 5 - 1$

P: _____

E: _____

M: _____

D: _____

A: _____

S: _____

2. $(3 \times 2) + 5^2 - 8 \div 2$

P: _____

E: _____

M: _____

D: _____

A: _____

S: _____

Simplify.

3. $12 \times 4 \div 2 + (7 - 5)^4$

_____

4. $1 + 2^3 - (4 \times 5) \div 10$

_____

Name _____ Date _____ Class _____

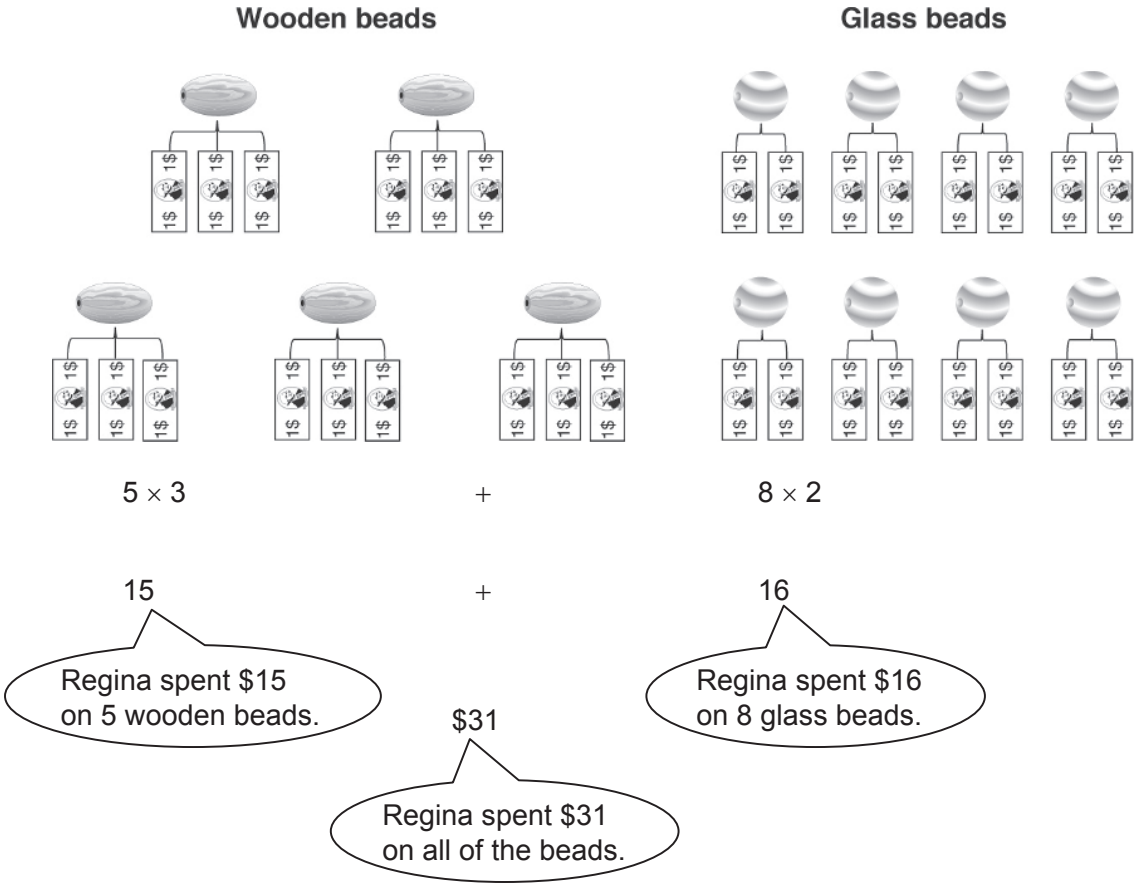
LESSON 9-3

Order of Operations

Success for English Learners

Problem 1

What did Regina spend on both glass and wooden beads?



1. Why do you have to multiply the number of beads by the price before adding?

_____

_____

2. When would you add the number of beads first and then multiply by the price?

_____

_____

Name _____ Date _____ Class_____

MODULE 9

Generating Equivalent Numerical Expressions

Challenge

1. Complete the table using the fact that the exponent in a power of 10 is the same as the number of zeros when the number is written out. Then use your observations to explain how you can find the product of any two powers of 10, $10^a \times 10^b$.

Product	Number of Zeros in Product	Product as Powers
$100 \times 1{,}000 =$		$10^2 \times 10^3 =$
$10 \times 100{,}000 =$		$10^1 \times 10^5 =$
$1{,}000 \times 10 =$		$10^3 \times 10^1 =$

_____

_____

2. List all the factors for each of the numbers in the table, which are grouped as perfect square numbers and non-perfect square numbers.

Perfect Square Numbers			Non-Perfect Square Numbers		
9	16	25	6	15	20

   a. Count the number of factors for each number. How does the number of factors for perfect square numbers compare to the number of factors for non-perfect square numbers?

   _____

   b. Use your observation to answer this question: What is the least whole number that has exactly 9 factors, including 1 and itself?

   _____

3. Insert parentheses to make each statement true. If parentheses are not needed, then say so.

   $28 \div 4 + 3 \times 48 \div 6 - 2 = 29$ _____

   $28 \div 4 + 3 \times 48 \div 6 - 2 = 30$ _____

   $28 \div 4 + 3 \times 48 \div 6 - 2 = 43$ _____

Name _____ Date _____ Class _____

LESSON 10-1

Modeling and Writing Expressions

Practice and Problem Solving: A/B

Solve.

1. Jessica rode 9 miles farther than Roger rode. Let r represent the number of miles Roger rode. Write an expression for the number of miles Jessica rode.

   _____

2. Let m represent the number of children playing soccer. Those children are separated into 4 equal teams. Write an expression for the number of children on each team.

   _____

3. Glenda bought some apps for her tablet. Each app cost $5. Let n represent the number of apps she bought. Write an expression to show the total amount she spent.

   _____

Write each phrase as a numerical or algebraic expression.

4. 25 multiplied by 3

   _____

5. 3 added to n

   _____

6. r divided by 8

   _____

7. the product of 7 and m

   _____

8. the difference between 48 and 13

   _____

9. the quotient of 18 and 3

   _____

10. 189 subtracted from t

    _____

11. the sum of w and 253

    _____

Write two word phrases for each expression.

12. $t + 23$ _____

13. $45 - n$ _____

Solve.

14. Write an expression that has two terms. Your expression should have a variable and a constant.

    _____

Name _____ Date _____ Class _____

LESSON 10-1

Modeling and Writing Expressions

Practice and Problem Solving: C

Solve.

1. Cal bought 2 packs of 100 paper plates and 1 pack of 60 paper plates. Write an expression for the total number of plates that he bought.

_____

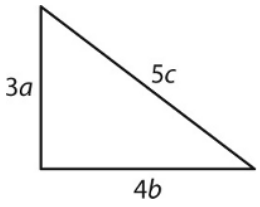
2. The temperature dropped 25°. Then the temperature went up 17°. Let t represent the beginning temperature. Write an expression to show the ending temperature.

_____

3. Jill purchased fruit juice boxes for a party. She purchased 1 case of 44 boxes and several packs containing 4 boxes each. Let p represent the number of 4-box packs she purchased. Write an expression for the total number of juice boxes Jill purchased.

_____

Use the figures at the right for Exercises 4–6.

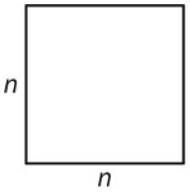


4. Write an expression for the perimeter of the triangle at the right.

_____

5. Write an expression for the perimeter of the square.

_____



6. Write an expression for the area of the square.

_____

Solve.

7. Write an expression that has four terms. Your expression should have three different variables and a constant.

_____

8. Josef said that he could represent the amount of money he made last week with the expression: $24d + 8n$. Write a problem about the money Josef made last week.

_____

_____

Name _____ Date _____ Class _____

LESSON 10-1

Modeling and Writing Expressions

Practice and Problem Solving: D

Circle the letter of the correct answer. The first one is done for you.

solution: result: answer

1. Which of the following is the **solution** to an addition problem?
   (A) sum
   B plus
   C add

2. Which word phrase represents the following expression $n - 3$?
   A the quotient of n and 3
   B 3 less than n
   C n less than 3

3. Which word phrase represents the following expression $5m$?
   A 5 fewer than m
   B m groups of 5
   C m divided by 5

4. Which of the following is the **solution** to a multiplication problem?
   A quotient
   B factor
   C product

5. Which word phrase represents the following expression $r \div 6$?
   A the product of r and 6
   B the quotient of r and 6
   C take away 6 from r

6. Which word phrase represents the following expression $3 + p$?
   A 3 increased by p
   B 3 decreased by p
   C the difference of 3 and p

Match the algebraic expressions A–E to Exercises 7–12. Some letters may be used more than once. Some letters may not be used at all. The first one is done for you.

A. $9x$ **B. $9 + x$** **C. $x - 9$** **D. $x \div 9$** **E. $9 - x$**

7. 9 less than x ___C___
8. the quotient of 9 and x ____
9. the sum of 9 and x ____
10. the product of 9 and x ____
11. x more than 9 ____
12. x decreased by 9 ____

Solve.

13. Nicole had 38 beads. She lost some of them. This can be modeled by the expression $38 - x$. What does x represent?

_____

14. Wilhelm bought some shirts. He paid $12 for each shirt. This can be modeled by the expression $12x$. What does x represent?

_____

Name _____ Date _____ Class _____

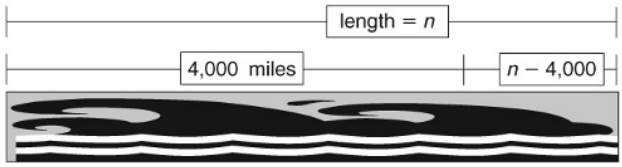
LESSON 10-1

Modeling and Writing Expressions

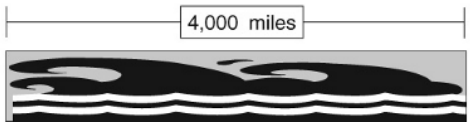
Reteach

Write an expression that shows how much longer the Nile River is than the Amazon River.

NILE RIVER



AMAZON RIVER



The expression is ***n* – 4,000**.

Each state gets the same number of senators. Write an expression for the number of senators there are in the United States Congress.

There are 50 states.

There are *s* senators from each state.

50*s*

The total number of senators is **50 times *s***.

Solve.

1. Why does the first problem above use subtraction?

   _____

2. Why does the second problem above use multiplication?

   _____

3. Jackson had *n* autographs in his autograph book. Yesterday he got 3 more autographs. Write an expression to show how many autographs are in his autograph book now.

   _____

4. Miranda earned $*c* for working 8 hours. Write an expression to show how much Miranda earned for each hour worked.

   _____

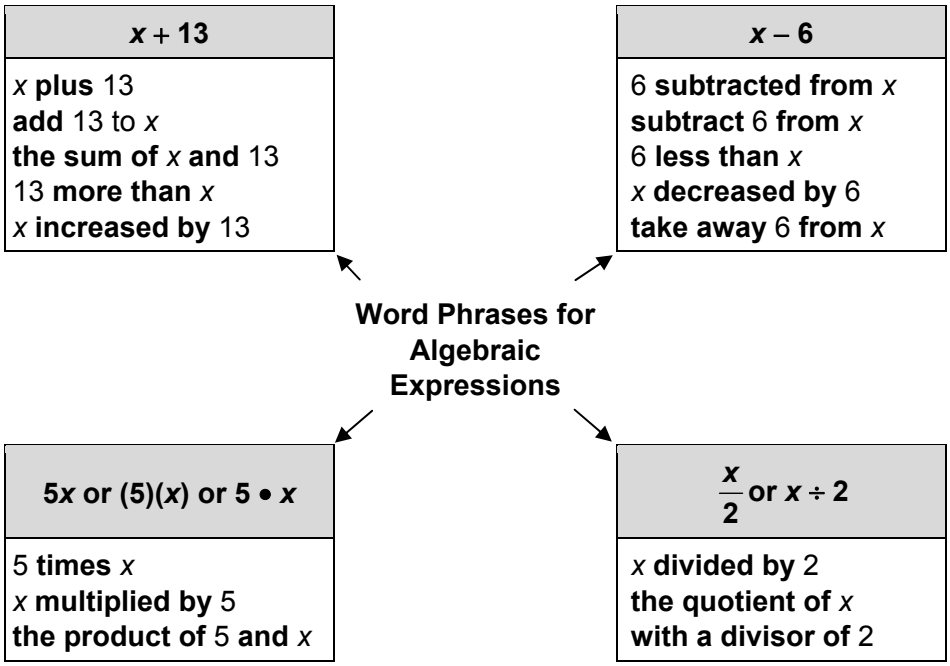
Name _____ Date _____ Class _____

LESSON 10-1

Modeling and Writing Expressions

Reading Strategies: Use a Visual Map

Identifying word phrases for different operations can help you understand and write algebraic expressions. This visual map shows the four different operations with key word phrases in boldface.



Write a word phrase for each algebraic expression.

1. $t - 8$ _____
2. $\frac{n}{6}$ _____
3. $4w$ _____
4. $z + 8$ _____
5. $9 \bullet m$ _____

Write an algebraic expression for each word phrase.

6. the sum of p and 12 _____
7. i decreased by 7 _____
8. the quotient of r with a divisor of 3 _____
9. z decreased by 1 _____
10. the product of y and 19 _____

Name _____ Date _____ Class _____

LESSON 10-1

Modeling and Writing Expressions

Success for English Learners

Problem 1

There are key words and phrases that tell you which operations to use for mathematical expressions.

Addition (combine)	**Subtraction** (compare, take away)	**Multiplication** (put together equal groups)	**Division** (separate into equal groups)
add plus sum total increased by more than	minus difference subtract less than decreased by take away	product times multiply	quotient divide divide by

Translate **words** and **phrases** into mathematical expressions:

3 **plus** 5 ⟶ $3 + 5$
4 **less than** p ⟶ $p - 4$
15 **times** n ⟶ $15n$
h **divided by** 4 ⟶ $h \div 4$

Problem 2

You can use key words to write word phrases for mathematical expressions. You can write different word phrases for the same expression.

$7k \rightarrow$ the **product of** 7 and k $\rightarrow$ 7 **times** k

$8 - 2 \rightarrow$ 2 **less than** 8 $\rightarrow$ 8 **minus** 2

$n + 10 \rightarrow$ 10 **more than** n $\rightarrow$ the **sum of** n and 10

Write each phrase as a numerical or algebraic expression.

1. m increased by 5 _____
2. 18 divided by 2 _____
3. the difference between t and 7 _____
4. r multiplied by 4 _____
5. x decreased by 9 _____
6. the quotient of 21 and 7 _____

Write a phrase for each expression.

7. $a - 2$ _____
8. $8 \bullet 6$ _____
9. $p \div 8$ _____
10. $v + 10$ _____

Name _____ Date _____ Class _____

LESSON 10-2

Evaluating Expressions

Practice and Problem Solving: A/B

Evaluate each expression for the given value(s) of the variable(s).

1. $a - 4$ when $a = 16$

_____

2. $2b + 9$ when $b = 3$

_____

3. $c \div 2$ when $c = 26$

_____

4. $5(9 + d) - 6$ when $d = 3$

_____

5. $g^2 + 23$ when $g = 6$

_____

6. $3h - j$ when $h = 8$ and $j = 11$

_____

7. $(n - 2) \bullet m$ when $n = 5$ and $m = 9$

_____

8. $r(s^2)(t)$ when $r = 2$, $s = 3$, and $t = 5$

_____

Use the given values to complete each table.

9.

p	$2(13 - p)$
2	
3	
4	

10.

v	w	$3v + w$
4	2	
6	3	
8	4	

11.

x	y	$x^2 \div y$
2	1	
6	2	
8	4	

Solve.

12. The sales tax in one town is 8%. So, the total cost of an item can be written as $c + 0.08c$. What is the total cost of an item that sells for $12?

_____

13. To change knots per hour to miles per hour, use the expression $1.15k$, where k is the speed in knots per hour. A plane is flying at 300 knots per hour. How fast is that plane flying in miles per hour?

_____

14. Lurinda ordered some boxes of greeting cards online. The cost of the cards is $\$6.50n + \$3$ where n is the number of boxes ordered and $3 is the shipping and handling charge. How much will Lurinda pay if she orders 8 boxes of cards?

_____

Name _____ Date _____ Class_____

LESSON 10-2

Evaluating Expressions

Practice and Problem Solving: C

Use the given values to complete each table.

1.

r	$3.14 \bullet r^2$
2	
3	
4	

2.

z	a	$2z - a$
–4	2	
0	2	
4	2	

3.

x	y	$10x^2 \div (y + 1)$
2	1	
–1	3	
–4	4	

Solve.

4. Melinda is hauling water in her pickup truck. An old bridge has a maximum weight limit of 6,000 pounds. To find the weight of her truck, Melinda uses the expression $5{,}275 + 8.36g$, where g is the number of gallons of water she is hauling. Can Melinda safely drive her pickup across the bridge if she is hauling 120 gallons of water? Explain.

_____

5. A certain machine produces parts that are rectangular prisms. The surface area of each part is found by using the expression $2s^2 + 4sh$, where s is the length of a side of the base and h is the height. What is the surface area of that part when s is 0.5 mm and h is 2 mm? _____ mm^2

Three students incorrectly evaluated $4x^2 + 2y$ for $x = 3$ and $y = -2$.
Use the table below to complete Exercises 6–9.

Grayson	**Emily**	**Pat**
$4x^2 + 2y = 4(3)^2 + 2(-2)$ $= 144 + (-4)$ $= 140$	$4x^2 + 2y = 4(3)^2 + 2(-2)$ $= 36 + 2(-2)$ $= 38(-2)$ $= -76$	$4x^2 + 2y = 4(3)^2 + 2(2)$ $= 36 + 4$ $= 40$

6. What error did Grayson make?

_____

7. What error did Emily make?

_____

8. What error did Pat make?

_____

9. Show the correct way to complete the evaluation of $4x^2 + 2y$ for $x = 3$ and $y = -2$.

_____

_____

Name _____ Date _____ Class _____

LESSON 10-2

Evaluating Expressions

Practice and Problem Solving: D

Evaluate each expression for the given value of the variable. Show each step you used. The first one is done for you.

1. $3n + 4^2$ when $n = 2$

   $3 \times \mathbf{2} + 4^2$ → Substitute 2 for n.

   $3 \times 2 + \mathbf{16}$ → Evaluate exponents.

   $\mathbf{6} + 16$ → Multiply.

   22 → Add.

2. $2 \times (a + 3)$ when $a = 5$

   $2 \times (5 + 3)$ → Substitute values.

   $2 \times$ ___ → Clear the parentheses.

   ___ → Multiply.

3. $r + r \div 2 \times 4$ when $r = 8$

   $8 + 8 \div 2 \times 4$ → Substitute values.

   $8 +$ ___ $\times 4$ → Multiply or divide from left to right, so divide first.

   $8 +$ ___ → Multiply.

   ___ → Add.

Use the given values to complete each table. The first one is done for you.

4.

w	$6(3 + w)$
2	30
3	36
4	42

5.

c	$2c + 7$
4	
6	
8	

6.

w	$w^2 - 3$
2	
3	
4	

Solve. Show your work.

7. The height of horses is measured in *hands*. To find the height of a horse in inches, use the expression $4h$, where h is the number of hands. Rosa has a horse that is 15 hands tall. How tall is Rosa's horse in inches?

   Rosa's horse is ____ inches tall.

Name _____ Date _____ Class_____

LESSON 10-2

Evaluating Expressions

Reteach

A **variable** is a letter that represents a number that can change in an expression. When you **evaluate** an algebraic expression, you substitute the value given for the variable in the expression.

- Algebraic expression: $x - 3$

  The value of the expression depends on the value of the variable x.

  If $x = 7 \rightarrow 7 - 3 = 4$

  If $x = 11 \rightarrow 11 - 3 = 8$

  If $x = 25 \rightarrow 25 - 3 = 22$

- Evaluate $4n + 5$ for $n = 7$.

  Replace the variable n with 7. $\rightarrow 4(7) + 5$

  Evaluate, following the order of operations. $\rightarrow 4(7) + 5 = 28 + 5 = 33$

Evaluate each expression for the given value. Show your work.

1. $a + 7$ when $a = 3$

   $a + 7 = 3 + 7 =$ ____

2. $y \div 3$ when $y = 6$

   $y \div 3 =$ ____ $\div 3 =$ ____

3. $n - 5$ when $n = 15$

   $n - 5 =$ ____ $- 5 =$ ____

4. $(6 + d) \bullet 2$ when $d = 3$

   $(6 + d) \bullet 2 = (6 +$ ____ $) \bullet 2$

   $=$ _____ $\bullet 2 =$ ____

5. $3n - 2$ when $n = 5$

   $3n - 2 = 3($ ____ $) - 2 =$ ____

6. $6b$ when $b = 7$

   _____

7. $12 - f$ when $f = 3$

   _____

8. $\frac{m}{5}$ when $m = 35$

   _____

9. $2k + 5$ when $k = 8$

   _____

10. $10 - (p + 3)$ when $p = 7$

    _____

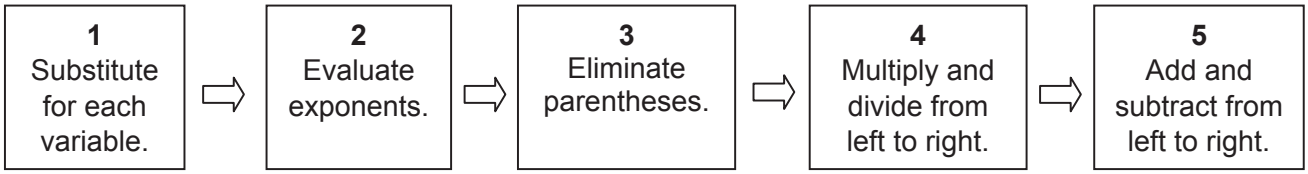
Name _____ Date _____ Class_____

LESSON 10-2

Evaluating Expressions

Reading Strategies: Use a Flowchart

A flowchart gives you a plan. You can use a flowchart to evaluate expressions.



Evaluate $x^2 - 3(4 + 1)$ when $x = 7$.

$7^2 - 3(4 + 1)$

49 – 3(4 + 1)

49 – 3(**5**)

49 – **15**

34

Plan
1 Substitute for each variable.
2 Evaluate exponents.
3 Eliminate parentheses.
4 Multiply and divide from left to right.
5 Add and subtract from left to right.

Evaluate $(2n + 8) \div t - 2$ when $n = 6$ and $t = 5$.

(2 • **6** + 8) ÷ **5** – 2

There are no exponents.

(12 + 8) ÷ 5 – 2
20 ÷ 5 – 2

4 – 2

2

Use the flowchart to evaluate each expression.

1.

Plan	Evaluate $(5 + y) - 3^2$ when $y = 14$.
1 Substitute for each variable.	
2 Evaluate exponents.	
3 Eliminate parentheses.	
4 Multiply and divide from left to right.	
5 Add and subtract from left to right.	

2.

Plan	Evaluate $m^2 - 2(3p + 6)$ when $m = 10$ and $p = 4$.
1 Substitute for each variable.	
2 Evaluate exponents.	
3 Eliminate parentheses.	
4 Multiply and divide from left to right.	
5 Add and subtract from left to right.	

Name _____ Date _____ Class _____

LESSON 10-2

Evaluating Expressions

Success for English Learners

Problem 1

Find the missing values in the table.

Step 1: Substitute for the variables.

Step 2: Compute. Follow the order of operations.

Evaluate $4 \times n + 6^2$ for each value of *n*.

n	$4 \times n + 6^2$	
2	$4 \times \mathbf{2} + 6^2 \rightarrow$ $4 \times 2 + \mathbf{36} \rightarrow$ $\mathbf{8} + 36 \rightarrow$ $44 \rightarrow$	Substitute 2 for *n*. Evaluate exponents. Multiply. Add.
5	$4 \times \mathbf{5} + 6^2 \rightarrow$ $4 \times 5 + \mathbf{36} \rightarrow$ $\_\_\_ + 36 \rightarrow$ $\_\_\_ \rightarrow$	Substitute 5 for *n*. Evaluate exponents. Multiply. Add.
9	$4 \times \mathbf{9} + 6^2 \rightarrow$ $4 \times 9 + \mathbf{36} \rightarrow$ $\_\_\_ + 36 \rightarrow$ $\_\_\_ \rightarrow$	Substitute 9 for *n*. Evaluate exponents. Multiply. Add.

Fill in the missing values in the table above.

Check your work.

Did you get a result of 56 when $n = 5$?

Did you get a result of 72 when $n = 9$?

Problem 2

Find the missing values in the table.

Step 1: Substitute for the variables.

Step 2: Compute. Follow the order of operations.

Evaluate $2l + 2w$ for the given values.

l	*w*	$2l + 2w$
4	3	$2 \times \mathbf{4} + 2 \times \mathbf{3} \rightarrow$ Substitute values. $\mathbf{8} + \mathbf{6} \rightarrow$ Multiply first. $14 \rightarrow$ Add.
5	2	$2 \times \mathbf{5} + 2 \times \mathbf{2} \rightarrow$ Substitute values. $\_\_\_ + \_\_\_ \rightarrow$ Multiply first. $\_\_\_ \rightarrow$ Add.
9	6	$2 \times \_\_\_ + 2 \times \_\_\_ \rightarrow$ Substitute. $\_\_\_ + \_\_\_ \rightarrow$ Multiply first. $\_\_\_ \rightarrow$ Add.

Fill in the missing values in the table above.

Check your work.

Did you get a result of 14 when $l = 5$ and $w = 2$?

Did you get a result of 30 when $l = 9$ and $w = 6$?

Use the given values to complete each table.

1.

r	$2(3 + r)$
2	
3	
4	

2.

c	*t*	$2c + t$
4	2	
6	3	
8	4	

3.

w	*k*	$w^2 - k$
2	1	
5	2	
8	3	

Name _____ Date _____ Class_____

LESSON 10-3

Generating Equivalent Expressions

Practice and Problem Solving: A/B

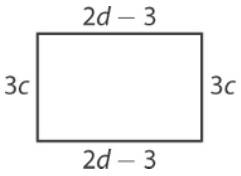
Justify each step used to simplify the expression.

1. $3x + 2y - 2x + 2 = 3x - 2x + 2y + 2$ _____
2. $= (3x - 2x) + 2y + 2$ _____
3. $= (3 - 2)x + 2y + 2$ _____
4. $= x + 2y + 2$ _____

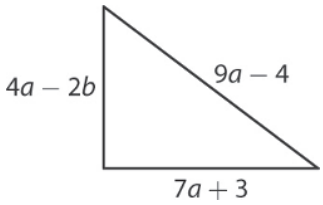
Simplify.

5. $3r + n^2 - r + 5 - 2n + 2$ _____
6. $8v + w + 7 - 8v + 2w$ _____
7. $4c^2 + 6c - 3c^2 - 2c - 3$ _____
8. $z^3 + 5z + 3z^2 + 1 - 4 - 2z^2$ _____

Write and simplify an expression for the perimeter of each figure.

9. 

_____

10. 

_____

11. A square has sides of $10x$. Write and simplify an expression for the perimeter of that square.

_____

12. A rectangle has a length of $2x + 7$ and a width of $3x + 8y$. Write and simplify an expression for the perimeter of that rectangle.

_____

13. In the space at the right, draw a triangle. Use an algebraic expression to label the length of each side. Write an expression for the perimeter of your triangle. Then simplify that expression.

_____

Name _____ Date _____ Class _____

LESSON 10-3

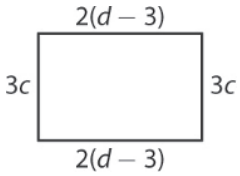
Generating Equivalent Expressions

Practice and Problem Solving: C

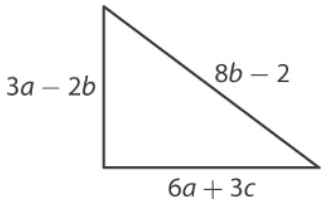
Simplify.

1. $3a + a^2 + 5(a - 2)$ _____
2. $8(v + w) - 7(v + 2w)$ _____
3. $4c^2 + 6(c - c^2) - 2c$ _____
4. $z^3 + 5(z + 3) - 4(2 - 2z^2)$ _____

Write and simplify an expression for the perimeter of each figure.

5. 

_____

6. 

_____

7. A square has sides of $x - 0.4$. Write an expression for the perimeter of that square. Simplify the expression.

_____

8. A rectangle has a length of $2(x + y)$ and a width of $3(x - y)$. Write an expression for the perimeter of that rectangle. Simplify the expression.

_____

Solve.

9. Peter collected soup for the food pantry. He packed 6 small boxes with n cans of soup in each box. He packed 4 boxes with twice as many cans as in the small boxes. Write and simplify an expression for the number of cans that Peter packed.

_____

10. Netta faxed n pages from the library. The library charges $1.50 per page. Later the same day, Netta faxed n more pages from a local copy shop. The copy shop charges $1.25 per page plus a $2 convenience fee. Write and simplify an expression for the amount Netta spent on faxes that day.

_____

Name _____ Date _____ Class _____

LESSON 10-3

Generating Equivalent Expressions

Practice and Problem Solving: D

Identify like terms in each list. The first one is done for you.

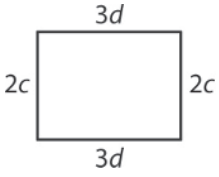
1. $5a$ b 43 $2a$ b^2 $2b$ 4 — **$5a$ and $2a$; b and $2b$; 43 and 4**
2. n $4n^3$ $2m$ $6m$ $5n$ $2n$ _____
3. $2d$ $5f$ $2g$ 7 $3g$ g _____
4. $7x^2$ x $3x^2$ 2 y^2 3 $3x$ _____

Combine like terms to simplify. The first one is done for you.

5. $4r + 5n^2 - 3r + 9 - 2n - 2$ — **$r + 5n^2 + 7 - 2n$**
6. $3v + w + 8 - 2v + 2$ _____
7. $8c^2 + 6c - 2c^2 - 5c$ _____
8. $z + 5e + 3z + 13 - 8 - 2e$ _____

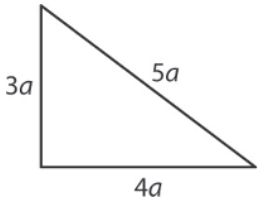
Perimeter is the distance around a figure. Write an expression for the perimeter of each figure. Be sure to combine like terms. The first one is done for you.

9.



$6d + 4c$

10.



_____

Circle the letter of the correct answer.

11. A square has sides of $6x$. Which expression shows the perimeter of that square?
    - A $6x$
    - B $12x$
    - C $24x$
    - D $36x$

12. A rectangle has a length of $4x + 5$ and a width of $8x - 4$. Which expression shows the perimeter of that rectangle?
    - A $4x + 1$
    - B $12x - 2$
    - C $12x + 1$
    - D $24x + 2$

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LESSON 10-3

Generating Equivalent Expressions

Reteach

Look at the following expressions: $x = 1x$
$x + x = 2x$
$x + x + x = 3x$

The numbers 1, 2, and 3 are called **coefficients** of x.

Identify each coefficient.

1. $8x$ ____ 2. $3m$ ____ 3. y ____ 4. $14t$ ____

An algebraic expression has terms that are separated by + and –.
In the expression $2x + 5y$, the **terms** are $2x$ and $5y$.

Expression	Terms
$8x + 4y$	$8x$ and $4y$
$5m - 2m + 9$	$5m$, $-2m$, and 9
$4a^2 - 2b + c - 2a^2$	$4a^2$, $-2b$, c, and $-2a^2$

Sometimes the terms of an expression can be combined.
Only **like terms** can be combined.

$2x + 2y$ NOT like terms, the variables are different.

$4a^2 - 2a$ NOT like terms, the exponents are different.

$5m - 2m$ Like terms, the variables and exponents are both the same.

$n^3 + 2n^3$ Like terms, the variables and exponents are both the same.

To **simplify** an expression, combine like terms by adding or subtracting the coefficients of the variable.

$\mathbf{5}m - \mathbf{2}m = \mathbf{3}m$

$4a^2 + \mathbf{5}a + \mathbf{a} + 3 = 4a^2 + \mathbf{6}a + 3$ Note that the coefficient of a is 1.

Simplify.

5. $8x + 2x$ _____

6. $3m - m$ _____

7. $6y + 6y$ _____

8. $14t - 3t$ _____

9. $3b + b + 6$ _____

10. $9a - 3a + 4$ _____

11. $n + 5n - 3c$ _____

12. $12d - 2d + e$ _____

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LESSON 10-3

Generating Equivalent Expressions

Reading Strategies: Organization Patterns

An algebraic expression is made up of parts called **terms**.

constants	variables	constants and variables
$3.2\ \frac{1}{2}\ 12$	$m\ s\ x$	$4x\ \frac{n}{2}\ 3m^2\ \frac{2}{3}y$

A **coefficient** is a value multiplied by a variable.

Term	Value of Coefficient	Meaning
$7x$	7	$7 \bullet x$
y	1	$1 \bullet y$
$\frac{n}{2}$	$\frac{1}{2}$	$\frac{1}{2} \bullet n$

The expression below has 6 terms.

Term	Term	Term	Term	Term	Term
↓	↓	↓	↓	↓	↓
$2x$ +	$5b$ +	7 −	b +	$3x$ +	$2x^2$

Like terms have **both** the same variable **and** the same exponent.
Like terms can have different coefficients.

Like Terms			Unlike Terms		
$2y$ and $3y$	$4b$ and b	$4n^2$ and $2n^2$	$3x$ and $2x^2$	$4x$ and b	$7n$ and $7m$

You can **simplify** an algebraic expression. To do that, you **combine** like terms.

First, reorganize the terms so like terms are together: $2x + 3x + 5b - b + 7 + 2x^2$
Then add or subtract coefficients to combine like terms: $5x + 4b + 7 + 2x^2$

Solve.

1. How many terms are there in this expression: $6b + b^2 + 5 + 2b - 3f$? ___ terms

2. $6b$ and b^2 are unlike terms. Explain why.

_____

Use $5a^2 + 6b + a^2 - 3b - 2 + 4c$ for Exercises 3–5.

3. How many terms are there in the expression? ___ terms

4. Reorganize the terms so like terms are together. _____

5. Combine like terms to rewrite the expression. _____

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LESSON 10-3

Generating Equivalent Expressions

Success for English Learners

Problem 1

Like terms → Same variables, Same exponents — Both **must** be true.

$6x^2$ and $2x^3$ → Same variables, different exponents, so **NOT like terms**

$4x^4$ and $5y^4$ → Different variables, same exponents, so **NOT like terms**

$3a^3$ and $6a^3$ → Same variables, same exponents, so **like terms**

Problem 2

Combining like terms

$8w + 9w$	Like terms	$7n^3 - n^3$	Like terms
$\mathbf{8}w + \mathbf{9}w$	Identify coefficients.	$\mathbf{7}n^3 - \mathbf{1}n^3$	Identify coefficients.
$17w$	Add ONLY the coefficients.	$6n^3$	Subtract ONLY the coefficients.

Answer the questions below.

1. Can you combine the terms $6x^2$ and $2x^3$ shown in Problem 1? If you can, then combine the terms. If you cannot, explain why not.

_____

2. Can you combine the terms $4x^4$ and $5y^4$ shown in Problem 1? If you can, then combine the terms. If you cannot, explain why not.

_____

3. Can you combine the terms $3a^3$ and $6a^3$ shown in Problem 1? If you can, then combine the terms. If you cannot, explain why not.

_____

4. When a term has no number in front of the variable, what is the coefficient of that variable?

_____

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MODULE 10

Generating Equivalent Algebraic Expressions

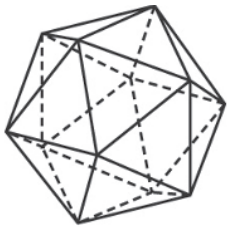
Challenge

Areas of Regular Figures

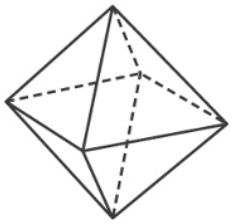
Regular polygons have equal side lengths and angle measures. Regular polyhedra are three-dimensional. Each regular polyhedron has congruent regular polygons for its faces. Four of these shapes are shown in the figures.

Identify each regular polygon. Then evaluate the area expression to find its area for a side length *s* of 5 centimeters.

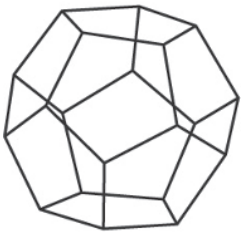
	Number of Sides	Name	Area Expression	Area for $s = 5$ cm
1.	3		$\frac{s^2}{4}\sqrt{3}$	
2.	4		s^2	
3.	5		$\frac{s^2}{4}\sqrt{25 + 10\sqrt{5}}$	
4.	6		$\frac{3s^2}{2}\sqrt{3}$	
5.	8		$2s^2(\sqrt{2} + 1)$	
6.	10		$\frac{5s^2}{2}\sqrt{5 + 2\sqrt{5}}$	



icosahedron



octahedron



dodecahedron

tetrahedron

Use the figures to identify each regular polyhedra. Then write an expression for its surface area for an edge length *s*.

	Number of Faces	Name	Surface Area for Edge Length *s*
7.	4 triangles		
8.	6 squares		
9.	8 triangles		
10.	12 pentagons		
11.	20 triangles		