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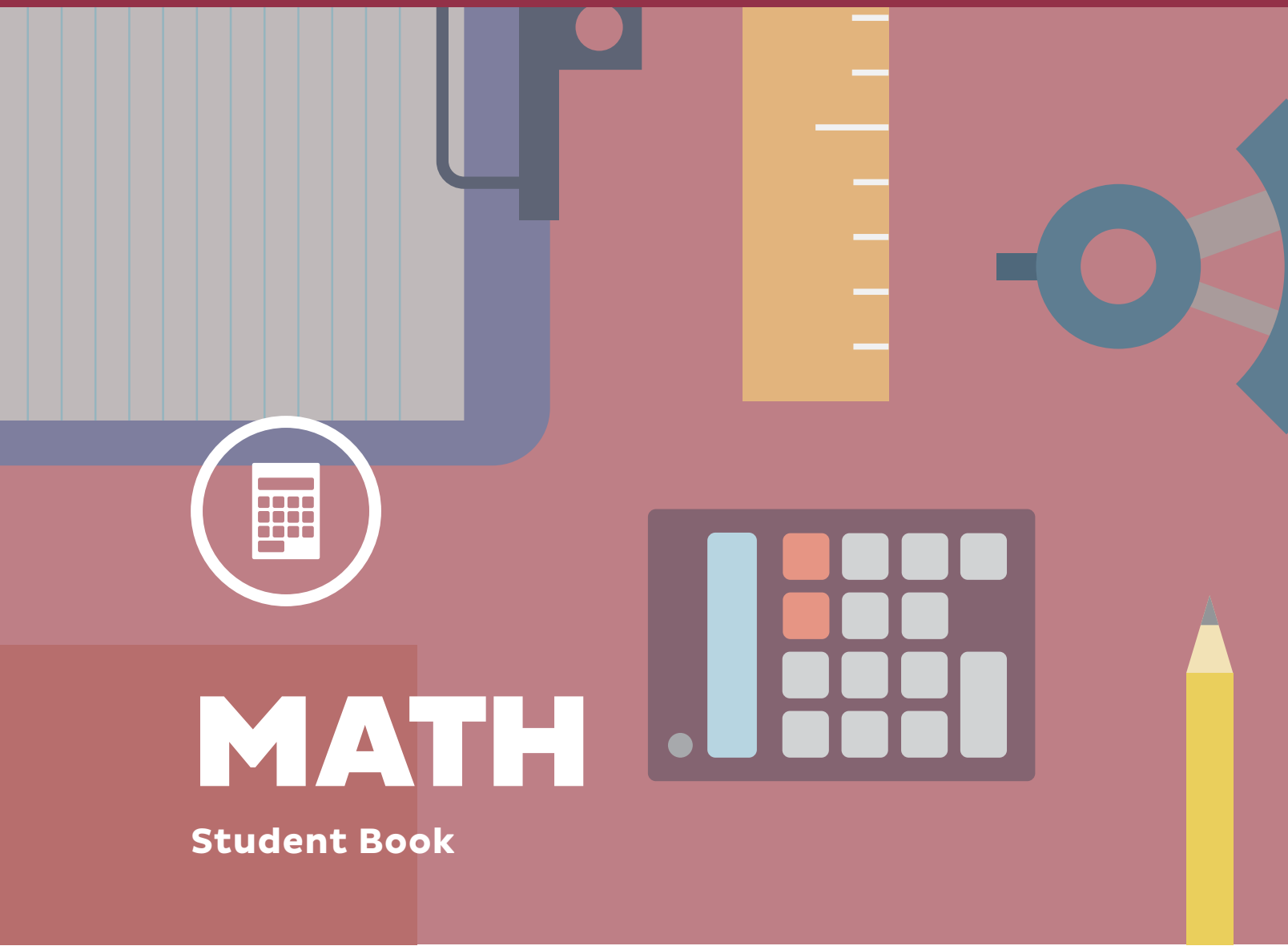


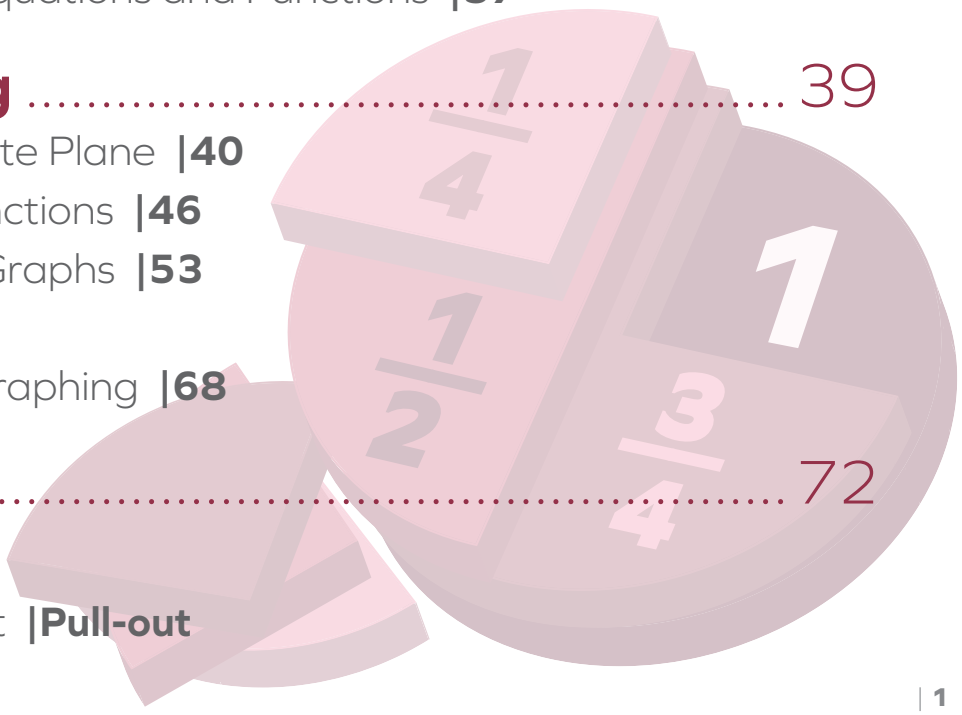
MATH

Student Book

5th Grade | Unit 4

Alpha Omega
PUBLICATIONS

MATH 504
ALGEBRA AND GRAPHING



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ALGEBRA AND GRAPHING

In this unit, you will be introduced to algebra—solving equations and graphing functions. You will begin by evaluating expressions for specific values, and then move to solving equations. You will also learn about the order of operations in evaluating and simplifying expressions. From there, you will learn about functions and find that while equations have one solution, and one variable, functions have infinite solutions and two variables. You will then list inputs and outputs for functions as ordered pairs and graph these in the coordinate plane, finding that they form a line. Finally, you will be introduced to negative numbers, which with positive numbers and zero form the set of integers. You will begin to notice patterns in functions and graphing, and you will find that algebra, and math itself, is really all about patterns.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

- Evaluate expressions and solve equations with one variable.
- Apply the rules for the order of operations.
- Find the output of functions.
- Graph ordered pairs and functions.
- Represent integers on the number line.

1. EXPRESSIONS

If Kyle is holding 5 pennies in one hand, and some more pennies in his other hand, how would you express mathematically the number of pennies Kyle is holding?

To do this, you would be using algebra to write a mathematical expression. In this lesson, you will be introduced to algebra and learn how to write mathematical expressions.

Objectives

Read these objectives. When you have completed this section, you should be able to:

- Write and evaluate addition or subtraction expressions.
- Write and evaluate multiplication expressions for a specific value, using substitution.
- Understand rules for the order of operations.
- Evaluate numerical expressions using order of operations.

Vocabulary

Study these new words. Learning the meanings of these words is a good study habit and will improve your understanding of this LIFEPAC.

algebra. A branch of mathematics that uses variables.

expression. A single term; multiple terms connected by an addition or subtraction sign.

order of operations. A system for simplifying expressions that ensures that there is only one right answer.

substitute. To replace a variable in a mathematical expression with an actual value.

term. A number, a variable, or the product of a number and variable(s).

variable. A letter used to represent an unknown number or quantity.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.*

Addition and Subtraction Expressions

Algebra is the area of mathematics that uses variables. This lesson is an introduction to algebra and using **variables**. Each three-digit part of a number, separated by commas, is called a period. And in each period, from right to left, the value of a digit is worth one, ten, and one hundred.

Writing and Evaluating Addition and Subtraction Expressions

The number of pennies in Kyle's closed hand is unknown. To represent this amount, we use a variable. A variable is a letter that represents an unknown quantity or number. We could represent the number of pennies in Kyle's closed hand using the letter p.

We know that Kyle has 5 pennies in his open hand. So, together in both hands, Kyle is holding $5 + p$ pennies. $5 + p$ is a mathematical **expression** that tells us the number of pennies Kyle is holding.

Each part of a mathematical expression is called a **term**. A number and a variable are terms. In the expression $5 + p$ there are two terms: 5 and p.

If Kyle were holding 6 pennies in his closed hand, how many pennies would he be holding altogether?

Now we have a known value for p (6), so we can **substitute** that value for the variable into the expression:

$5 + p \qquad p = 6$

$5 + 6 = 11$

So, Kyle is holding 11 pennies.

When we evaluate an expression, we will get a different result depending on the value of the variable. The number that is substituted for the variable determines the solution.

Let's assume different numbers of pennies in Kyle's closed hand and see how our choices affect the number of pennies he is holding:

$p = 7 \qquad p = 9 \qquad p = 0$

For each value of the variable (the number of pennies in Kyle's closed hand), we will substitute that number into the expression $5 + p$:

$p = 7 \qquad p = 9 \qquad p = 0$

$5 + 7 = 12 \qquad 5 + 9 = 14 \qquad 5 + 0 = 5$

So, the number of pennies Kyle is holding depends on the value of p.

Be careful!

Although 0 is "nothing," it is a quantity and can be the value of a variable.

Let's look at some other expressions where there is a known value for the variable.

Example:

Evaluate each expression for the given value of the variable:

$7 + x$, if $x = 4$

$9 - n$, if $n = 6$

$8 - z$, if $z = 7$

Solution:

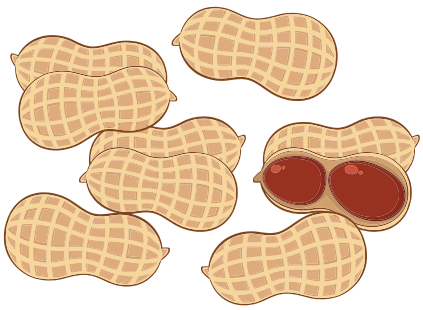
For each expression we will substitute the value of the variable, and then simplify the expression:

$7 + x$, if $x = 4$	$7 + 4 = 11$
$9 - n$, if $n = 6$	$9 - 6 = 3$
$8 - z$, if $z = 7$	$8 - 7 = 1$

As we have seen, mathematical expressions can be used to represent real-life situations.

Example:

Sean takes 20 peanuts on a hike and eats some while walking. Write an expression to represent the number of peanuts he has at the end of his hike. How many peanuts would Sean have if he ate 15 during the hike?



Solution:

Sean starts with 20 peanuts and eats some, so that amount is subtracted from 20. The number of eaten peanuts is unknown, so it will be the variable n: $20 - n$.

If we know that he ate 15 peanuts during the hike, we can substitute the known value of n into the expression:

$20 - n$, if $n = 15$

$20 - 15 = 5$

So, if Sean eats 15 peanuts during the hike, he will have 5 left at the end of the hike.

Let's Review!

Before going on to the practice problems, make sure you understand the main points of this lesson.

- ✓ Algebra is a branch of mathematics that uses variables to represent unknown values.
- ✓ A mathematical expression uses terms to represent quantities.
- ✓ Known values can be substituted into expressions to evaluate the expression.

Complete this activity.

1.1 Match the terms with their definitions.

a. _____ algebra

b. _____ expression

c. _____ substitute

d. _____ term

e. _____ variable

1. a single term; multiple terms connected by an addition or subtraction sign
2. a branch of mathematics that uses variables
3. a number, a variable, or the product of a number and variable(s)
4. to replace a variable in a mathematical expression with an actual value
5. a letter used to represent an unknown number or quantity

Circle the correct letter and answer.

1.2 Evaluate the expression $x - 7$, if $x = 12$.

a. 19 b. 17 c. 6 d. 5

1.3 Sue has 14 pencils, but gives some to her friends. Which expression represents the number of pencils Sue has?

a. $x + 14$ b. $x - 14$ c. $14 + x$ d. $14 - x$

1.4 If $m = 8$, how many solutions are there for the expression $m - 8$?

a. 0 b. 1 c. 2 d. infinite

1.5 Evaluate the expression $x + 9$, if $x = 8$.

a. 1 b. 2 c. 17 d. 89

1.6 Which expression has a solution of 5, if $r = 3$?

a. $r - 8$ b. $r + 2$ c. $15 - r$ d. $r + 8$

1.7 Debbie has 53 stamps in her collection but buys some more. Which expression represents the number of stamps Debbie has collected?

a. $53 + s$ b. $s - 53$ c. $53 - s$ d. $53 + 6$

1.8 Evaluate the expression $23 - x$, if $x = 8$.

a. 15 b. 17 c. 30 d. 31

1.9 Which expression does not have a solution of 9, if $w = 4$?

a. $5 - w$ b. $w + 5$ c. $13 - w$ d. $5 + w$

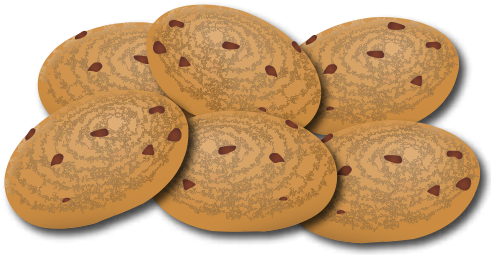
Complete this activity.

1.10 Match each expression with its value, if $x = 6$.

a. _____ $4 + x$
b. _____ $x - 5$
c. _____ $x + 6$
d. _____ $x - 6$
e. _____ $9 - x$

1. 1
2. 3
3. 12
4. 10
5. 0

Multiplication Expressions



If Grace gives each of her friends 3 cookies, how would you express mathematically the number of cookies Grace gives to her friends?

You have probably noticed that there is an unknown quantity in the cookie example (the number of friends Grace has), so a variable will be involved in the expression. In this lesson, you will continue to write mathematical expressions. You will practice using multiplication to evaluate expressions.

Writing and Evaluating Multiplication Expressions

The number of friends that Grace gives cookies to is unknown, so that quantity can be represented using a variable. We could represent the number of friends using the letter f.

We know that Grace gives 3 cookies to each friend. So, the total amount of cookies is $3 \times f$.

In algebra, when a variable is multiplied by a number, the number is written in front of the variable, so $3 \times f = 3f$. In a mathematical expression, $3f$ is one term.

If Grace has 6 friends, how many cookies did she give out?

Now we have a known value for f (6), so we can substitute that value for the variable into the expression:

$3f$, if $f = 6$
$3 \times 6 = 18$

So, Grace gives out 18 cookies.

When we evaluate an expression, we will get a different result depending on the value of the variable. The number that is substituted for the variable determines the solution.

Did you know?

When the known value is substituted for the variable in a multiplication expression, remember to multiply the variable by the number. Do not just substitute the value for the variable next to the number.

If $f = 6$, $3f \neq 36$

Let's see how the total number of cookies changes, depending on the number of friends Grace has. Let's say Grace has 2, 10, or 8 friends.

$f = 2$ $\quad$ $f = 10$ $\quad$ $f = 8$

For each value of the variable (the number of friends Grace has), we will substitute that number into the expression $3f$:

$3f$	$3f$	$3f$
$3 \times 2 =$	$3 \times 10 =$	$3 \times 8 =$
6	30	24

So, the amount of cookies Grace gives out depends on the value of f.

Let's look at some other expressions where there is a known value for the variable.

Example:

Evaluate each expression for the given value of the variable:

$8x$, if $x = 5$

$9n$, if $n = 7$

$8z$, if $z = 10$

Solution:

For each expression we will substitute the value of the variable, and then simplify the expression:

$8x$, if $x = 5$	$8 \times 5 = 40$
$9n$, if $n = 7$	$9 \times 7 = 63$
$8z$, if $z = 10$	$8 \times 10 = 80$

As we have seen, mathematical expressions can be used to represent real-life situations.

Example:

Doug mows lawns on weekends and is paid $15 for each lawn. Write an expression to represent the amount of money Doug earns. How much money does Doug earn if he mows 8 lawns?

Solution:

Doug is paid $15 for *each* of the lawns he mows, so we will multiply $15 by the number of lawns he mows. The number of lawns he mows is unknown, so it will be the variable m:

$15m$

If we know that he mows 8 lawns, we can substitute the known value of m into the expression:

$15m$, if $m = 8$

$\$15 \times 8 = \$120$

So, if Doug mows 8 lawns, at $15 each, he will earn $120.

Example:

The following weekend Doug mows 10 lawns. If he is still paid $15 for each lawn he mows, how much money will Doug earn?

Solution:

We know that the amount of money Doug earns is shown by the expression $15m$, where m is the number of lawns he mows.

If we know that he mows 10 lawns, we can substitute the known value of m into the expression:

$15m$, if $m = 10$

$\$15 \times 10 = \$150$

So, if Doug mows 10 lawns, at $15 each, he will earn $150.

Let's Review!

Before going on to the practice problems, make sure you understand the main points of this lesson.

- ✓ In a multiplication expression, the number multiplied by the variable is written in front of the variable. Example: $3f$.
- ✓ Known values can be substituted into expressions to evaluate the expression.

Fill in the blank.

1.11 _____ are used to represent an unknown quantity in a mathematical expression.

Circle the correct letter and answer.

1.12 Evaluate the expression $7x$, if $x = 11$.

a. 4 b. 18 c. 77 d. 711

1.13 Frank deposits $20 a week into his bank account for several weeks. Which expression represents the amount of money in Frank's account?

a. $20d$ b. $20 + d$ c. $7d$ d. $20 - d$

1.14 If $m = 8$, how many solutions are there for the expression $7m$?

a. 0 b. 1 c. 2 d. infinite

1.15 Evaluate the expression $9x$, if $x = 5$.

a. 4 b. 14 c. 45 d. 95

1.16 Which expression has a solution of 27, if $r = 3$?

a. $6r$ b. $7r$ c. $8r$ d. $9r$

1.17 Ben plants 6 rows of roses, with the same number of roses in each row. Which expression represents the number of roses Ben has planted?

a. $r + 6$ b. $6r$ c. 6×6 d. $8r$

1.18 Evaluate the expression $21x$, if $x = 4$.

a. 17 b. 25 c. 84 d. 214

1.19 Which expression has a solution of 54, if $t = 6$?

a. $6t$ b. $7t$ c. $8t$ d. $9t$

Complete this activity.

1.20 Match each expression with its value, if $x = 8$.

a. _____ $10x$
b. _____ $8x$
c. _____ $7x$
d. _____ $6x$
e. _____ $9x$

1. 56
2. 80
3. 64
4. 48
5. 72

SELF TEST 1: EXPRESSIONS

Each numbered question = 6 points

Circle the correct letter and answer.

1.01 Evaluate the expression $x + 5$, if $x = 8$.

a. 3 b. 5 c. 8 d. 13

1.02 Which expression has a solution of 12, if $m = 7$?

a. $m - 5$ b. $m + 7$ c. $5 - m$ d. $m + 5$

1.03 Sarah has 16 coins, but spends some of them during the day. Which expression represents the number of coins Sarah currently has?

a. $c - 16$ b. $16c$ c. $16 - c$ d. $16 + c$

1.04 Which expression does *not* have a solution of 14, if $w = 9$?

a. $5 + w$ b. $w - 9$ c. $23 - w$ d. $w + 5$

1.05 Evaluate the expression $x - 9$, if $x = 15$.

a. 6 b. 9 c. 12 d. 24

1.06 Evaluate the expression $7x$, if $x = 8$.

a. 1 b. 15 c. 56 d. 78

1.07 Which expression has a solution of 36, if $p = 4$?

a. $7p$ b. $8p$ c. $9p$ d. $10p$

1.08 John collects $5 for club dues from each member. Which expression represents the amount of money John has collected?

a. $5d$ b. $5 + d$ c. 5×12 d. $d - 5$

1.09 Which expression does *not* have a solution of 12, if $w = 4$?

a. $3w$ b. $w + 8$ c. $16 - w$ d. $4w$

1.010 Evaluate the expression $3x$, if $x = 7$.

a. 4 b. 10 c. 21 d. 37

1.011 Evaluate the expression $12 - 3 \times 3 - 2$.

a. 1 b. 9 c. 12 d. 25

1.012 Add parentheses to the expression $3 + 9 \div 9 - 6$ so that its value is 6.

a. $(3 + 9) \div 9 - 6$ b. $3 + (9 \div 9) - 6$

c. $3 + 9 \div (9 - 6)$ d. no parentheses are needed

1.013 What should be done first to evaluate the expression $6 + 8 \div 4 + (4 \times 5)^2$?

a. Multiply 4 by 5
b. Add 6 and 8
c. Divide 8 by 4
d. Evaluate the exponent

1.014 Evaluate the expression $5 + 3 \times (5 - 2)^2$.

a. 16
b. 32
c. 36
d. 72

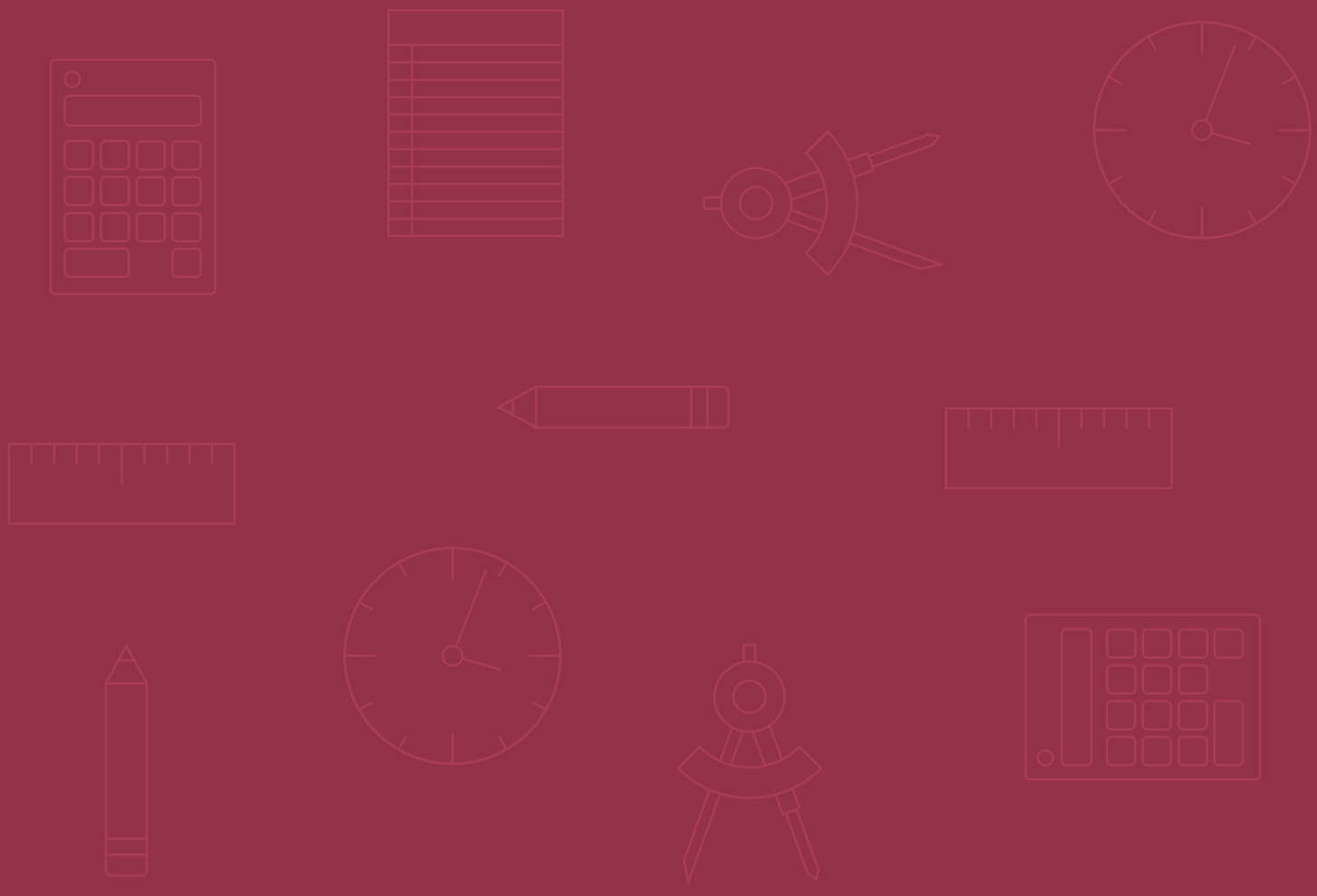
1.015 What should be done so that the expression $4 + 4^2 - 5 \times 2$ will have a value of 10?

a. Add parentheses around $4 + 4$
b. Add parentheses around $4^2 - 5$
c. Add parentheses around $4 + 4^2 - 5$
d. Nothing needs to be done.

Teacher check: Initials _____

Score _____ Date _____

72/90



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800-622-3070
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MAT0504 – Jan '16 Printing

ISBN 978-0-7403-3484-9