Vocabulary

● Review

1. Write two examples of *numerical expressions* and *algebraic expressions.*

Numerical Expressions   **Algebraic Expressions**

2. Reasoning Lan has three pens and some pencils. Why does she need an algebraic expression to represent the number of writing tools she has? Explain.

● Vocabulary Builder

counterexample (noun) KOWN **tur eg** ZAM **pul**

Definition: A **counterexample** is an example that shows that a statement is not always true.

> You need only one **counterexample** to prove that a statement is false.

Related Words: counteract (verb), counterargument (noun), counterclockwise (adjective)

Example: For all real numbers, $a + b = a \cdot b$ is a *false* statement. You can show the statement is false by using a **counterexample** like the one below.

$$5 + 3 = 8 \text{ is } not \text{ equal to } 5 \cdot 3 = 15.$$

● Use Your Vocabulary

Draw a line from each statement to a *counterexample* that shows it to be false.

Statement	Counterexample
3. If you live in Miami, you live in Florida.	Mexico is in North America.
4. If you live near an ocean, you live near the Atlantic Ocean.	People in California live near the Pacific Ocean.
5. If you live in North America, you live in the United States.	Miami is a city in Ohio.

Properties   Properties of Real Numbers

Draw a line from each property in Column A to the equation that illustrates it in Column B.

Column A	Column B
6. Associative Property of Addition	$15y + 0 = 15y$
7. Associative Property of Multiplication	$7b \cdot 2 = 2 \cdot 7b$
8. Commutative Property of Addition	$(c \cdot 3) \cdot 5 = c \cdot (3 \cdot 5)$
9. Commutative Property of Multiplication	$6x + 5y = 5y + 6x$
10. Identity Property of Addition	$a \cdot 1 = a$
11. Identity Property of Multiplication	$(g + 11h) + 9h = g + (11h + 9h)$
12. Multiplication Property of -1	$7k \cdot 0 = 0$
13. Zero Property of Multiplication	$15m \cdot (-1) = -15m$

Problem 1   Identifying Properties

Got It? What property is illustrated by $4x \cdot 1 = 4x$?

14. For each question, determine if the stated characteristic is or is not being illustrated by $4x \cdot 1 = 4x$.

Is the same number being added to both sides of the equation?   Yes / No

Are groupings being changed in the equation?   Yes / No

Is 0 or 1 part of the equation?   Yes / No

15. Think of the operation symbol that will make the equation $4x \; ■ \; 1 = 4x$ true. What property is illustrated by $4x \cdot 1 = 4x$?

Problem 2   Using Properties for Mental Calculations

Got It? A can holds 3 tennis balls. A box holds 4 cans. A case holds 6 boxes. How many tennis balls are in 10 cases? Use mental math.

16. Complete the boxes below to write an expression for the number of tennis balls in 10 cases.

Relate	number of cases of tennis balls	times	number of boxes per case	times	number of cans per box	times	number of tennis balls per can
Write	☐	·	☐	·	☐	·	☐

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17. Mental Math Circle the simplified expression.

24   60   120   720

18. What is one of the properties you used to simplify the expression? Explain how you used the property.

_____

_____

Problem 3 Writing Equivalent Expressions

Got It? Simplify each expression.

$2.1(4.5x)$ $6 + (4h + 3)$ $\dfrac{8m}{12mn}$

In Exercises 19–20, each expression is simplified. Justify each step.

19. $2.1(4.5x) = (2.1 \cdot 4.5)x$

_____

$\quad\quad\quad\quad = 9.45x$

_____

20. $6 + (4h + 3) = (4h + 3) + 6$

_____

$\quad\quad\quad\quad\quad = 4h + (3 + 6)$

_____

$\quad\quad\quad\quad\quad = 4h + 9$

_____

21. Complete each step of the simplification.

$$\dfrac{8m}{12mn} = \dfrac{2 \cdot \boxed{} \cdot \boxed{} \cdot 1}{3 \cdot 4 \cdot m \cdot n}$$

$$= \dfrac{2}{3} \cdot \dfrac{\boxed{}}{\boxed{}} \cdot \dfrac{\boxed{}}{\boxed{}} \cdot \dfrac{1}{n} = \dfrac{2}{3} \cdot \boxed{} \cdot \boxed{} \cdot \dfrac{1}{n} = \dfrac{2}{3} \cdot \boxed{} = \boxed{}$$

Problem 4 Using Deductive Reasoning and Counterexamples

Got It? Reasoning Is the statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.

For all real numbers j and k, $j \cdot k = (k + 0) \cdot j$.

22. Simplify the right side of the equation above and state the property that you used.

$(k + 0) \cdot j = \boxed{} \cdot j$

_____

23. Complete: The simplified expression is equal to $j \cdot k$ by the __?__ Property of Multiplication.

_____

24. So, the statement $j \cdot k = (k + 0) \cdot j$ is __?__.   True / False

Got It? Reasoning Is the statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.

For all real numbers m and n, $m(n + 1) = mn + 1$.

Evaluate each expression for $m = 4$ and $n = 5$.

25. $m(n + 1) = $ ☐ $\cdot ($ ☐ $+ 1)$

　　　　 $= $ ☐ $\cdot$ ☐

　　　　 $= $ ☐

26. $mn + 1$

27. Is the value of the expression in Exercise 25 equal to the value of the expression in Exercise 26?　　　Yes / No

28. Is the original statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.

_____

_____

Lesson Check • Do you UNDERSTAND?

Justify each step to show that $3 \cdot (10 \cdot 12) = 360$.

29. The left side of the expression is simplified below. Write a reason for each step.

$3 \cdot (10 \cdot 12) = 3 \cdot (12 \cdot 10)$　_____

　　　　　　　 $= (3 \cdot 12) \cdot 10$　_____

　　　　　　　 $= 36 \cdot 10$　_____

　　　　　　　 $= 360$　_____

Math Success

Check off the vocabulary words that you understand.

☐ Commutative Properties　　☐ Associative Properties　　☐ Identity Properties

　☐ equivalent expressions　　☐ deductive reasoning　　☐ counterexample

Rate how well you can *use the properties of addition and multiplication.*

Need to review　0　2　4　6　8　10　Now I get it!