LESSON 11

7.EE.1, 7.EE.2

Writing Equivalent Expressions

1 GETTING THE IDEA

A **variable** is a symbol or letter that represents one or more numbers. The **coefficient** of a variable is a numerical factor that precedes the variable. For example, in the expression $6x$, the variable is x, the coefficient is 6, and the expression $6x$ means $6 \cdot x$.

A **term** is a number, variable, product, or quotient in an expression. Terms can be separated by an addition sign or subtraction sign. In the expression $-8x + 2.5y + 0.73$, the terms are $-8x$, $2.5y$, and 0.73.

When rewriting expressions, determine if terms are **like terms**. Like terms have the same variables with the same corresponding exponents. For example, $-0.9n$ and $4n$ are like terms because both include the same variable raised to the power of 1. However, $-0.9n$ and $5p$ are not like terms because the variables are different. To combine like terms, add the coefficients of the terms. If two terms are not like terms, they cannot be combined.

The associative, commutative, identity, and inverse properties may help you compute answers. The following property may also be helpful.

Zero Property of Multiplication

For any rational number a:

$a \cdot 0 = 0$

Example 1

Write an equivalent expression for $-9n + 12 \cdot \frac{n}{4}$.

Strategy Follow the order of operations.

Step 1 First multiply.

$$-9n + 12 \cdot \frac{n}{4} = -9n + \left(\frac{12}{1} \cdot \frac{1}{4}n\right)$$

$$= -9n + \frac{12}{4}n$$

$$= -9n + 3n$$

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Step 2 Combine like terms, if any.

$-9n$ and $3n$ are like terms.

$-9n + 3n = (-9 + 3)n = -6n$

Solution **An equivalent expression for $-9n + 12 \cdot \frac{n}{4}$ is $-6n$.**

Example 2

Write an equivalent expression for $0.8x + 0.3x + 2$.

Strategy **Use properties of operations to combine like terms.**

Step 1 Identify like terms.

$0.8x$ and $0.3x$ are like terms.

Step 2 Use the distributive property to add like terms.

$(0.8x + 0.3x) + 2 = (0.8 + 0.3)x + 2 = 1.1x + 2$

$1.1x$ and 2 are not like terms. They cannot be combined.

Solution **An equivalent expression for $0.8x + 0.3x + 2$ is $1.1x + 2$.**

Example 3

Write an equivalent expression for $\frac{3}{4}a \times \left[\left(-\frac{5}{6}a\right) + \frac{5}{6}a\right]$.

Strategy **Use properties of operations to combine like terms.**

Step 1 Use the additive inverse property to simplify the expression inside.

$-\frac{5}{6}a$ and $\frac{5}{6}a$ are additive inverses. Their sum is 0.

$\frac{3}{4}a \times \left[-\frac{5}{6}a + \frac{5}{6}a\right] = \frac{3}{4}a \times 0$

Step 2 Use the zero property of multiplication to simplify the rest.

The product of any number and 0 is 0.

$\frac{3}{4}a \times 0 = 0$

Solution **An equivalent expression is 0.**

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Example 4

The price of each belt sold at a craft fair is equal to the cost, in dollars, to make the belt plus a 60% markup. If the cost, in dollars, to make the belt is c, write an expression to represent the price of each belt. Then simplify the expression.

Strategy **Use properties of operations to write an equivalent expression.**

Step 1 Write an expression to represent the price of a belt after markup.

Let c represent the cost of making a belt.

The markup is 60%.

$60\% = \frac{60}{100} = 0.60 = 0.6$

So, the amount of the markup is equal to $0.6c$.

The new price will be $c + 0.6c$.

Step 2 Use the distributive property to rewrite the expression.

$$c + 0.6c = (1 + 0.6)c$$
$$= 1.6c$$

So, marking up the cost by 60% is the same as multiplying the cost by 1.6.

Solution **The expressions $c + 0.6c$ and $1.6c$ both represent the price of a belt after markup.**

2 COACHED EXAMPLE

A painting is one third as wide as it is long. An expression for the perimeter of the painting is $\frac{1}{3}x + x + \frac{1}{3}x + x$. What is an equivalent expression for the perimeter of the painting?

To combine like terms, _____ the coefficients of the like terms.

What are the like terms in the expression? _____

Use the distributive property to combine like terms. Remember, $x = (_____)x$.

$\frac{1}{3}x + x + \frac{1}{3}x + x = (_____ + _____ + _____ + _____)x$

$= _____x$

An equivalent expression for the perimeter of the painting is _____.

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3 LESSON PRACTICE

1. Are the expressions equivalent? Select Yes or No.

A. $3z + 2z$ and $5z$	○ Yes	○ No
B. $(8x - 8x) - y$ and 0	○ Yes	○ No
C. $9.1 + 4.5a - 2.5a$ and $11.1a$	○ Yes	○ No
D. $-7y \times 3 - 3$ and 0	○ Yes	○ No
E. $y - 6(3)$ and $y - 18$	○ Yes	○ No

2. Brett simplified $12y + 7y \cdot 3$ to $19y \cdot 3$.

Brett says his expressions are equivalent. Is Brett correct or incorrect? Explain.

3. A coat is on sale for 35% off. The regular price of the coat is p. Write and simplify an expression to represent the sale price of the coat. Show your work.

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4 Select True or False for each equation.

A. $\frac{n}{2} + 3 \times 4 = \frac{n}{2} + 12$ ○ True ○ False

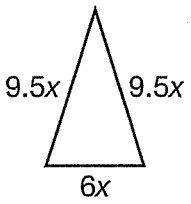
B. $\frac{1}{3}z + \frac{2}{3}z \times 9 = 9z$ ○ True ○ False

C. $-8y + 4.3y + 3.7 = 0$ ○ True ○ False

D. $12 - 1.8b + 1.8b = 1.8b$ ○ True ○ False

E. $\frac{m}{8} + 7\left(\frac{m}{8}\right) = m$ ○ True ○ False

5 The lengths, in units, of the sides of an isosceles triangle are given below.



Write and simplify an expression to represent the perimeter of the triangle. Show your work.

6 A tutor earns d dollars per hour. He will be increasing his hourly wage by 10% starting next month. He tells one of his clients that his new wage can be determined by multiplying his previous wage by 1.1. Is he correct? Write expressions to justify your answer.

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7 Raven earns extra money when her neighbors are on vacation. Raven is paid $12 per day when she cares for the Martin family's cat. She is paid $5.50 per day when she waters the Clark family's plants.

Part A

Write an expression to represent how much Raven earns for each of the following:

watching the Martin family's cat for *n* days: _____

watering the Clark family's plants for *n* days: _____

Part B

Write and simplify an expression to represent how much Raven earns if she performs both jobs for *n* days. Show your work and explain what the simplified expression means.

8 Keitaro buys a hat that is on sale for 15% off. He says that the total amount he will pay will be equal to 75% of the regular price of the hat. Is he correct? Write an expression to justify your answer.

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