BARTLETT

NAME DATE PERIOD

Unit 6, Lesson 21: Combining Like Terms (Part 2)

Let's see how to use properties correctly to write equivalent expressions.

21.1: True or False? 5 mins.

Select **all** the statements that are true. Be prepared to explain your reasoning. only look @ one @ a time

addition symmetry — Distribute first

1. $4 - 2(3 + 7) = 4 - 2 \cdot 3 - 2 \cdot 7$ True, & each product must be subtracted from 4
2. $4 - 2(3 + 7) = 4 + -2 \cdot 3 + -2 \cdot 7$ True, subtracting 2 = adding -2
3. $4 - 2(3 + 7) = 4 - 2 \cdot 3 + 2 \cdot 7$ False. 2·7 needs to be subtracted
4. $4 - 2(3 + 7) = 4 - (2 \cdot 3 + 2 \cdot 7)$ True, 2 distributed, all subtracted from 4

valuation yields $-16 = 12$

21.2: Seeing it Differently 8 mins.

Some students are trying to write an expression with fewer terms that is equivalent to $8 - 3(4 - 9x)$.

Substitution

Noah says, "I worked the problem from left to right and ended up with $20 - 45x$."

$$8 - 3(4 - 9x)$$
$$5(4 - 9x)$$
$$20 - 45x$$

Subtracted before multiplying

Lin says, "I started inside the parentheses and ended up with $23x$."

$$8 - 3(4 - 9x)$$
$$8 - 3(-5x)$$
$$8 + 15x$$
$$23x$$

combined 4 & 9x

Jada says, "I used the distributive property and ended up with $27x - 4$."

$$8 - 3(4 - 9x)$$
$$8 - (12 - 27x)$$
$$8 - 12 - (-27x)$$
$$27x - 4$$

Andre says, "I also used the distributive property, but I ended up with $-4 - 27x$."

$$8 - 3(4 - 9x)$$
$$8 - 12 - 27x$$
$$-4 - 27x$$

multiplied -3 and -9, but got -27

1. Do you agree with any of them? Explain your reasoning.

Jada is correct — substitution method

2. For each strategy that you disagree with, find and describe the errors.

21.3: Grouping Differently

10 mins. can place parentheses anywhere

Diego was taking a math quiz. There was a question on the quiz that had the expression $8x - 9 - 12x + 5$. Diego's teacher told the class there was a typo and the expression was supposed to have one set of parentheses in it.

Answer both independently, 5 mins. to write. 5 mins. to discuss

1. Where could you put parentheses in $8x - 9 - 12x + 5$ to make a new expression that is still equivalent to the original expression? How do you know that your new expression is equivalent?

correct/explain

$(8x - 9 - 12x + 5)$

$(8x - 9)8 - 12x + 5$

2. Where could you put parentheses in $8x - 9 - 12x + 5$ to make a new expression that is not equivalent to the original expression? List as many different answers as you can.

$= -88x - 32$

4 $8x - 9 - (2x + 5)$ $= -4x - 14$

2/ $8x - (9 - 12x) + 5$ $= 20x - 4$

3/ $8x - (9 - 12x + 5)$ $= 20x - 14$

Unit 6, Lesson 22: Combining Like Terms (Part 3)

4/ $8(x - 9 - (2x) + 5$

$= -88x - 67$

5/ $8(x - 9) - 12x +$

$= -4x - 67$

Let's see how we can combine terms in an expression to write it with less terms.

5 mins.

22.1: Are They Equal?

subtraction might still be tricky → additive inverse

Select **all** expressions that are equal to $8 - 12 - (6 + 4)$.

* 1. $8 - 6 - 12 + 4$
2. $8 - 12 - 6 - 4$
* 3. $8 - 12 + (6 + 4)$

subtraction sign outside the parentheses applies to the +4 too

* 4. $8 - 12 - 6 + 4$
5. $8 - 4 - 12 - 6$

subtraction in front of 12 does not also apply to the (6+4)

22.2: X's and Y's

10 mins.

Match each expression in column A with an equivalent expression from column B. Be prepared to explain your reasoning.

Column A	Column B
#1 A. $(9x + 5y) + (3x + 7y)$	1. $12(x + y)$ A
#6 B. $(9x + 5y) - (3x + 7y)$	2. $12(x - y)$ E
#4 C. $(9x + 5y) - (3x - 7y)$	3. $6(x - 2y)$ F
#5 D. $9x - 7y + 3x + 5y$	4. $9x + 5y + 3x - 7y$ C
#2 E. $9x - 7y + 3x - 5y$	5. $9x + 5y - 3x + 7y$ D
#3 F. $9x - 7y - 3x - 5y$	6. $9x - 3x + 5y - 7y$ B

22.3: Seeing Structure and Factoring

Write each expression with fewer terms. Show or explain your reasoning.

18 - 45 + 27

1 min. to compute
As fast as possible

1. $3 \cdot 15 + 4 \cdot 15 - 5 \cdot 15$

$2 \cdot 15$

$= 30$

Factor 15

$15(3+4-5)$

$15(2)$

30

$9(2-5+3)$

$9(0) = \emptyset$

Notice Factors!

2. $3x + 4x - 5x$

$= 2x$

Factor x

$x(3+4-5)$

$= x(2)$

3. $3(x-2) + 4(x-2) - 5(x-2)$

$(x-2)(3+4-5)$

$= (x-2)2$

Factor $(x-2)$

$= 2(x-2)$

4. $3\left(\frac{5}{2}x + 6\frac{1}{2}\right) + 4\left(\frac{5}{2}x + 6\frac{1}{2}\right) - 5\left(\frac{5}{2}x + 6\frac{1}{2}\right)$

$(3+4-5)\left(\frac{5}{2}x + 6\frac{1}{2}\right)$

Factor $\left(\frac{5}{2}x + 6\frac{1}{2}\right)$

$= (2)\left(\frac{5}{2}x + 6\frac{1}{2}\right)$

$= 5x + 13$

Lesson 21 Summary

Combining like terms allows us to write expressions more simply with fewer terms. But it can sometimes be tricky with long expressions, parentheses, and negatives. It is helpful to think about some common errors that we can be aware of and try to avoid:

- $6x - x$ is not equivalent to 6. While it might be tempting to think that subtracting x makes the x disappear, the expression is really saying take 1 x away from 6 x's, and the distributive property tells us that $6x - x$ is equivalent to $(6 - 1)x$.

- $7 - 2x$ is not equivalent to $5x$. The expression $7 - 2x$ tells us to double an unknown amount and subtract it from 7. This is not always the same as taking 5 copies of the unknown.

- $7 - 4(x + 2)$ is not equivalent to $3(x + 2)$. The expression tells us to subtract 4 copies of an amount from 7, not to take $(7 - 4)$ copies of the amount.

If we think about the meaning and properties of operations when we take steps to rewrite expressions, we can be sure we are getting equivalent expressions and are not changing their value in the process.

Lesson 22 Summary

Combining like terms is a useful strategy that we will see again and again in our future work with mathematical expressions. It is helpful to review the things we have learned about this important concept.

- Combining like terms is an application of the distributive property. For example:

$$\begin{aligned} &2x + 9x \\ &(2 + 9) \cdot x \\ &11x \end{aligned}$$

- It often also involves the commutative and associative properties to change the order or grouping of addition. For example:

$$\begin{aligned} &2a + 3b + 4a + 5b \\ &2a + 4a + 3b + 5b \\ &(2a + 4a) + (3b + 5b) \\ &6a + 8b \end{aligned}$$

- We can't change order or grouping when subtracting; so in order to apply the commutative or associative properties to expressions with subtraction, we need to rewrite subtraction as addition. For example:

$$\begin{aligned} &2a - 3b - 4a - 5b \\ &2a + \text{-}3b + \text{-}4a + \text{-}5b \\ &2a + \text{-}4a + \text{-}3b + \text{-}5b \\ &\text{-}2a + \text{-}8b \\ &\text{-}2a - 8b \end{aligned}$$

- Since combining like terms uses properties of operations, it results in expressions that are equivalent.

- The like terms that are combined do not have to be a single number or variable; they may be longer expressions as well. Terms can be combined in any sum where there is a common factor in all the terms. For example, each term in the expression $5(x + 3) - 0.5(x + 3) + 2(x + 3)$ has a factor of $(x + 3)$. We can rewrite the expression with fewer terms by using the distributive property:

$$\begin{aligned} &5(x + 3) - 0.5(x + 3) + 2(x + 3) \\ &(5 - 0.5 + 2)(x + 3) \\ &6.5(x + 3) \end{aligned}$$