

Lesson 20: Combining Like Terms (Part 1)

Let's see how we can tell that expressions are equivalent.

20.1: Why is it True?

Explain why each statement is true.

1. $5 + 2 + 3 = 5 + (2 + 3)$

2. $9a$ is equivalent to $11a - 2a$.

3. $7a + 4 - 2a$ is equivalent to $7a + -2a + 4$.

4. $8a - (8a - 8)$ is equivalent to 8.

20.2: A's and B's

Diego and Jada are both trying to write an expression with fewer terms that is equivalent to

$$7a + 5b - 3a + 4b$$

- Jada thinks $10a + 1b$ is equivalent to the original expression.
- Diego thinks $4a + 9b$ is equivalent to the original expression.

1. We can show expressions are equivalent by writing out all the variables. Explain why the expression on each row (after the first row) is equivalent to the expression on the row before it.

$$\begin{array}{c}
 7a + 5b - 3a + 4b \\
 (a + a + a + a + a + a + a) + (b + b + b + b + b) - (a + a + a) + (b + b + b + b) \\
 (a + a + a + a) + (a + a + a) + (b + b + b + b + b) - (a + a + a) + (b + b + b + b) \\
 (a + a + a + a) + (b + b + b + b + b) + (a + a + a) - (a + a + a) + (b + b + b + b) \\
 (a + a + a + a) + (b + b + b + b + b) + (b + b + b + b) \\
 (a + a + a + a) + (b + b + b + b + b + b + b + b + b) \\
 4a + 9b
 \end{array}$$

2. Here is another way we can rewrite the expressions. Explain why the expression on each row (after the first row) is equivalent to the expression on the row before it.

$$7a + 5b - 3a + 4b$$

$$7a + 5b + (-3a) + 4b$$

$$7a + (-3a) + 5b + 4b$$

$$(7 + -3)a + (5 + 4)b$$

$$4a + 9b$$

Are you ready for more?

Follow the instructions for a number puzzle:

- Take the number formed by the first 3 digits of your phone number and multiply it by 40
- Add 1 to the result
- Multiply by 500
- Add the number formed by the last 4 digits of your phone number, and then add it again
- Subtract 500
- Multiply by $\frac{1}{2}$

1. What is the final number?

2. How does this number puzzle work?

3. Can you invent a new number puzzle that gives a surprising result?

20.3: Making Sides Equal

Replace each ? with an expression that will make the left side of the equation equivalent to the right side.

Set A

1. $6x + ? = 10x$

2. $6x + ? = 2x$

3. $6x + ? = -10x$

4. $6x + ? = 0$

5. $6x + ? = 10$

Check your results with your partner and resolve any disagreements. Next move on to Set B.

Set B

1. $6x - ? = 2x$

2. $6x - ? = 10x$

$$3. 6x - ? = x$$

$$4. 6x - ? = 6$$

$$5. 6x - ? = 4x - 10$$

Lesson 20 Summary

There are many ways to write equivalent expressions that may look very different from each other. We have several tools to find out if two expressions are equivalent.

- Two expressions are definitely not equivalent if they have different values when we substitute the same number for the variable. For example, $2(-3 + x) + 8$ and $2x + 5$ are not equivalent because when x is 1, the first expression equals 4 and the second expression equals 7.
- If two expressions are equal for many different values we substitute for the variable, then the expressions *may* be equivalent, but we don't know for sure. It is impossible to compare the two expressions for all values. To know for sure, we use properties of operations. For example, $2(-3 + x) + 8$ is equivalent to $2x + 2$ because:

$$2(-3 + x) + 8$$

$$-6 + 2x + 8 \quad \text{by the distributive property}$$

$$2x + -6 + 8 \quad \text{by the commutative property}$$

$$2x + (-6 + 8) \quad \text{by the associative property}$$

$$2x + 2$$