

Resource Properties of Algebra

Overview

On these pages, several important mathematical rules and relationships are given that can help you perform calculations in different ways. The formal names for the rules are also given. You do not have to memorize these names for this course, but you may use them in other math courses. If you want more help with any of the rules, use the formal names to find resources on the internet.

The role of variables in these examples

The mathematical rules are defined in terms of variables. The variables are symbols, usually letters that represent numbers. You use variables to show that the rule can apply to a lot of different numbers. This is called generalizing because it shows that a rule can be used in general and not just in specific cases. The rules will be shown using variables, and then an example will be given that uses numbers.

While mathematical rules are very important, in this course, the authors emphasize reasoning over memorizing the names of rules. As you review the rules, try to make sense of them so they become a part of your thinking.

Caution:

**Be sure you notice which operations
 can be used with each property!**

Commutative property

The order of addition and multiplication can be changed. It is important to remember that the commutative property *does not* apply to subtraction and division.

General Rule	Example
$a + b = b + a$	$8 + 3 = 3 + 8 = 11$
$a \times b = b \times a$	$5 \times 6 = 6 \times 5 = 30$

For more information about the commutative property, watch this video:

- https://www.khanacademy.org/math/arithmetric/order-of-operations/arithmetric_properties/v/commutative-property-for-addition

Distributive property

General Rule	Example
<p>$a \times (b + c) = a \times b + a \times c$</p> <p>also shown as</p> <p>$a(b + c) = ab + ac$</p> <p>Note about subtraction: Subtraction is related to addition. The distributive property is shown using addition, but it also works with subtraction:</p> <p>$8(5 - 1) = 8 \times 5 - 8 \times 1$</p> <p>Notation: The operation of multiplication is shown in many ways. In the above example, we see the multiplication symbol (\times). We also see a number or variable in front of the parenthesis with no other symbol. For example:</p> <p>$6(2) = 6 \times 2$</p> <p>$a(b) = a \times b$</p> <p>You will learn other symbols for multiplication later in the course.</p>	<p>$4(3 + 1) = 4 \times 3 + 4 \times 1$</p> <p>To demonstrate that these two calculations are equivalent, each side is done separately.</p> <p>Left side: Using Order of Operations, the operation inside the parentheses is done first:</p> <p>$4(3 + 1)$ $4(4)$ 16</p> <p>Right side: Using the distributive property, the multiplication is <i>distributed</i> over the addition:</p> <p>$4(3 + 1)$ $4 \times 3 + 4 \times 1$</p> <p>Order of Operations tells you to multiply first.</p> <p>$12 + 4$ 16</p>

For more information about the distributive property, visit:

- https://www.khanacademy.org/math/arithmetic/multiplication-division/distributive_property/v/the-distributive-property

[**Note:** The word *distributive* is misspelled in this web address. If the address doesn't work, try the correct spelling, as the website may have corrected the error.]

Division

Dividing by a number results in the same outcome as multiplication by the reciprocal of the number. To determine the reciprocal of a number, write the number as a fraction and switch the numerator (the top number) and the denominator (bottom number). For example, the reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

General Rule	Example
$a \div b = a \times \frac{1}{b}$	$15 \div 5 = 15 \times \frac{1}{5}$
$a \div \frac{b}{c} = a \times \frac{c}{b}$	$10 \div \frac{3}{5} = 10 \times \frac{5}{3}$
<p>Caution:</p> <p>$15 \times \frac{1}{15}$ is the same as $\frac{1}{15} \times 15$ <u>but</u> $15 \div 5$ is <u>not</u> the same as $5 \div 15$</p>	

