

Today we're going to talk about the properties of addition and multiplication. We use these properties when we are simplifying expressions and solving equations. So we'll go ahead and go over five different properties and then we'll do some examples with numbers using those properties.

So the first property is called the identity property. And we have an identity property for both addition and multiplication. The identity property of addition says that some number a plus 0 is just equal to a . So not really a new idea, but still important for us to know when we're simplifying and solving equations. If we put numbers to this, I could have a number 5 plus 0 and we know that that's still equal to 5. So basically adding 0 to a number does not change it.

Similarly for multiplication, my identity property is some number a times 1 is still equal to that number a . So with a number for a , we could have negative 3 times 1 and that's still equal to negative 3. So again, the idea is that multiplying something by one does not change the original value.

Our second property is called the inverse property. And again, we have one for addition and multiplication. So the inverse property for addition tells us that a plus the opposite of a is equal to 0. So this is showing us that adding two numbers that are opposites of each other basically cancel each other out. So with the numbers, if we had our a equal to 3 plus the opposite of 3, which would be negative 3, we know that that's going to be equal to 0.

And if we look at the inverse property for multiplication, this is saying that some number a over 1, which would just be the same as a , times the reciprocal of that, so 1 over a , is going to be equal to 1. This is looking at the operations of multiplication and division as being inverse of each other. So with numbers, we could have 7 over 1 times 1 over 7. When I'm multiplying fractions I know I just multiply numerator, numerator and denominator, denominator. So this will be 7 over 7 which is equal to 1.

Our third property is called the commutative property. And the commutative property for addition tells us we can add numbers in any order and for multiplication, it tells us we can multiply numbers in any order. So for addition, that property looks like a plus b is the same as b plus a . So if we put numbers that should mean that 3 plus 4 is the same as 4 plus 3. 3 plus 4 is 7 and 4 plus 3 is 7. So this works.

We can also extend the commutative property to be for more than just two numbers. For example, if I had negative 2 plus 5 plus 1. Negative 2 plus 5 is going to give me 3 and 3 plus 1 is going to give me 4. So I should be able to change the order of these numbers and still the answer should still be 4. So let's see if I had 5 plus 1 plus my negative 2. 5 plus 1 is 6 and 6 plus a negative 2 is equal to 4. So we see that it doesn't matter. You can use this property for more than just two numbers.

So similarly, the property for multiplication tells us that a times b is equal to b times a . So with numbers, we could have a negative 5 times 2 and that should be equal to 2 times negative 5. Negative 5 times 2 gives me negative 10. And still 2 times negative 5 is going to also give me negative 10.

Our next property is called the associative property. And this property tells us that we can group numbers in any order that we want when we're adding and we can also group numbers in any order when we're multiplying. So sometimes it's easy to get the associative and the commutative property mixed up. I like to remember that the associative property involves grouping numbers, so using our grouping symbols-- parentheses-- that we can group numbers or associate numbers in any order that we wish.

So for addition, the associative property tells us that some number a plus b plus c is also the same as a plus b plus c . So for example, if I have negative 3 plus 4 plus 2 that should be the same as negative 3 plus 4 plus 2. So if I simplify the left side, 4 plus 2 gives me 6. And if I add negative 3 to that, negative 3 plus 6 gives me 3.

On the right side, if I start with negative 3 plus 4, that will give me positive 1. And if I add 2 to that, that also gives me 3. So we see that the associative property does work for addition.

Let's look at multiplication. With multiplication, it tells us that some number a multiplied by b and c is the same as a and b multiplied together and then multiplied by c . So for example, if I have 3 times 4 times 5, this should be the same as 3 times 4 and then multiply that by 5. So simplifying on the left side, 4 times 5 will give me 20. If I multiply 3 times 20 that gives me 60.

And on the right side, 3 times 4 will give me 12. And if I multiply 12 by 5, that's also going to give me 60. So we can see that the associative property also works for multiplication. Now the associative property works for more than just three numbers. It can work for any number of numbers. So let's do an example using four numbers.

So let's say I have negative 5 plus 6 plus 3 plus 1. That should be the same as negative 5 plus 6 plus 3 plus 1. So we're just grouping them in a different way. So 6 plus 3 will give me 9. Bring down my 1 and my negative 5. Negative 5 plus 9 will give me 4. And 4 plus 1 will give me 5.

On the right side, negative 5 plus 6 will give me 1. And 3 plus 1 will give me 4. Simplifying this, 1 plus 4 gives me 5. So I can see, again, that even with more than three numbers, the associative property still works.

Our fifth and final property is called the distributive property, which is a property of multiplication. And this property tells us that the product of a sum and some factor can also be expressed as the sum of the products of the original factor and each addend. Let's put some numbers with this. So let's say I have 3 times 2 plus 6. This property is telling us that should be equal to 3 times 2 plus 3 times 6.

So $2 + 6$ will give me 8. And when I multiply 3 times 8, that's going to give me 24. On this side, 3 times 2 gives me 6. 3 times 6 gives me 18. And when I add them together I do get 24.

Now the distributive property can also be looked at backwards, which is the process of factoring. So let's look at an example of that. Let's say I had two numbers, 12 and 18. Now 12 and 18 have a common factor. 3 can be multiplied by some number to give you 12 and to give you 18. So I can factor out a 3 from both of these numbers.

So if I bring a 3 on the outside of the parentheses, 3 times 4 will give me 12 and 3 times 6 will give me 18. So this is factoring. Now let's see if those two things are equal to each other. $12 + 18$, that gives me 30. And now if I simplify the factored expression, $4 + 6$ will give me 10. And when I multiply 3 times 10 that does give me 30.

So let's go over our key points from today. Make sure you get these down in your notes if you don't have them already so that you can refer to them later. So we went over different properties for addition and multiplication. We looked at an identity property, an inverse property, a commutative property, the associative property, and then for multiplication, we had a final property of distribution.

So I hope that these examples and these key points helped you understand a little bit more about the properties of addition and multiplication. Keep using your notes and keep on practicing and soon you'll be a pro. Thanks for watching.