

Algebra,

Been there – Done that

Evaluating Algebraic Expressions

Mathematical Systems

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Algebra, Been there –Done that is a newsletter that links algebra to previously learned concepts and skills or outside experiences

Order of Operations is just an agreement that allows us to get the same answer.

Boston 5
Denver 2

The game is being played in Denver

Evaluating algebraic expressions is done exactly the same way students evaluated arithmetic expressions in grade school. In fact, when students in grade school used formulas to find such things as area, perimeter, or volume, they were actually evaluating algebraic expressions.

In arithmetic, we found that when we compute, we should get one and only one answer. Otherwise we would run into a lot of confusion. For instance, let's say we were asked to compute $4 + 2 \times 5$. One student might reasonable compute from left to right and add the two to four, then multiply by five. That would result in 30. Another student might reasonably multiply the two by five and add four. That result would be 14.

The immediate problem is one computation results in two different answers. That would be confusing. Since we would prefer not to be confused, we often make agreements in our daily lives so everyone does the same thing. As an example, we all drive on the right side of the road. Without that agreement, we would have greater opportunities to run into friends more often. When we list competitions, the home team is listed second. That way we always know where the game is being played. We have many agreements in life that helps us all do the same thing to avoid confusion.

Order of Operations

LEFT to RIGHT

1. Grouping
2. Exponentials
3. Mult/Div
4. Add/Sub

In order to avoid confusion in mathematics, we have agreed to compute using the Order of Operations.

Order of Operations

Compute from LEFT to RIGHT in the following order.

1. Grouping
2. Exponentials
3. Multiplication/Division
4. Addition/Subtraction

Division is defined in terms of multiplication.

$$a \div b = a \times \frac{1}{b}$$

$$8 \div 4 = 8 \times \frac{1}{4}$$

This agreement will allow us all to get the same answer for a given problem. Using this agreement in the first problem, $4 + 2 \times 5$, the result will be 14.

Notice multiplication and division are on the same line. That's because division is defined in terms of multiplication. In other words, dividing a number by 2 is the same as multiplying by $\frac{1}{2}$.

A common mistake for students is to multiply before dividing. If you have multiplication and division on the same line, you perform the operation that comes first.

$$5 + 36 \div 6 \times 2 + 3 = 20$$

Subtraction is defined in terms of addition.

If you multiplied before you divided, your answer would have been incorrect.

$$a - b = a + (-b)$$

To evaluate algebraic expressions, you simply substitute the numbers in for letters, then use the Order of Operations to compute in the agreed upon order.

EXAMPLE Evaluate $a + bc$ if $a = 2$, $b=3$, and $c =5$

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Substituting, we have $2 + 3 \times 5$, the answer is 17