

Evaluating Algebraic Expressions

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If you were asked to compute $2 + 3 \times 4$, what would be the result?

Someone might decide to do the problem by first adding the 2 and the 3, then multiplying by 4. The result would be 20.

Another person might do the same problem by multiplying the 3 and the 4 first, then adding the 2. That result would be 14.

Clearly you can see that having two different answers to the same problem might cause some confusion. The methods used in computing each seem reasonable. Can we say both answers are correct? If we do, we will certainly run into difficulties later.

In arithmetic, we would like problems to have “one and only one” answer. Can you imagine a mathematical system that would allow you to get different answers for the same problem? That would be very confusing.

Since we prefer not to be confused, we often make agreements in our daily life so everybody does the same thing. Notice, we all agree to drive on the right hand side of the road. We could have just as easily agreed to drive on the left. When we list competitions, we list the home team second. Therefore, if I asked you where the game L.A. vs. Boston is being played, you could say Boston. We have many agreements in life that help us all do the same thing. That avoids confusion.

We do the same in mathematics, we have agreed on a procedure to compute arithmetic and algebraic expressions called the Order of Operations.

Order of Operations

From LEFT to RIGHT in this order

1. Grouping
2. Exponentials
3. Multiply / Divide
4. Add / Subtract

This agreement will enable us all to get the same answer to problems. Learn it!

Using this agreement, we see the answer to the problem $2 + 3 \times 4$ is 14.

I can't make evaluating these expressions harder, I can only make them longer.

EXAMPLE: Evaluate $3 + 4 \times 2 - 24 \div 6$

Using the Order of Operations, we first do anything in parentheses, we have none. Second, we do exponentials. Again, we have none. Next we do all multiplication and division from right to left.

$$= 3 + 4 \times 2 - 24 \div 6$$

$$= 3 + 8 - 4$$

Now we do all the addition and subtraction from right to left. The answer is 7. Yes, math is a blast! I know you want to try one on your own. Try this one.

EXAMPLE: Evaluate $7 + (4 + 2)^2 \div 9 + 4 \times 3$

Follow the Order of Operations from right to left. You should get 23.

In algebra, we use the Order of Operations to evaluate algebraic expressions. Those are often called formulas.

EXAMPLE: Evaluate $3a + 2b$, if $a = 4$ and $b = 5$

First substitute the values for a and b in the problem. Doing that we have $3 \times 4 + 2 \times 5$. Using the Order of Operations, we find the answer is 22.

Remember, the Order of Operations is just an agreement that allows everyone to do the problem the same way to avoid confusion.

The Order of Operations is also used to solve equations.