

Order of Operations

Think of the mathematics operations that you know: Addition, Subtraction, Multiplication, and Division. There are others, such as exponentiation, and for lack of a better term, “roots.”

Addition is the most basic operation. Subtraction is the opposite (or inverse) of Addition.

Multiplication is just “souped-up” Addition. Instead of $7+7+7+7$, we can say 4×7 .

Division is the opposite (inverse) of Multiplication.

Therefore, Multiplication and Division are more “powerful” than Addition and Subtraction, and so, they have the potential to get more done, faster.

Exponents and Roots are super-charged Multiplication and Division. Think of it like this: If you wanted to cut a bunch of wood, would you use a hand saw, an electric saw, or a chain saw? Start with the chain saw and use it until it quits working!

So we developed an order of operations that tells us which steps to do first. This is commonly abbreviated as PEMDAS. It stands for Parentheses, Exponents (including Roots), Multiplication/Division, and Addition/Subtraction. Some teachers write it thus:

P
E(R)
MD
AS

We often use the phrase “Please Excuse My Dear Aunt Sally” to help us remember the order. The “R” is usually not listed. When you have a math expression to simplify:

- 1.) First, look for Parentheses or other grouping symbols (Brackets, etc.). Do them!
- 2.) When there are no more grouping symbols, look for exponents. Do them!
- 3.) Look through the remaining steps and do Multiplication or Division next, from left to right.
- 4.) You should now have only Addition and Subtraction left, so do them from left to right. These are the steps you follow when all terms are known.

When you are solving an Algebraic equation, start at the bottom of the list above, and remove Addition and Subtraction first, then work up the list.

Parentheses is not an operation. It is a signal that you should do a step out of its normal order. If any of the steps are missing from your expression, just skip them.

Examples: (I’ll underline the steps as I do them)

$$\begin{array}{r} 9 + 5(3)^3 \div 3 - 2(3 + 4) \\ 9 + 5(3)^3 \div 3 - 2(7) \\ 9 + 5(27) \div 3 - 2(7) \\ 9 + 135 \div 3 - 2(7) \\ 9 + 45 - 14 \\ 54 - 14 \\ 40 \end{array}$$

$$\begin{array}{r} 2^3 + 3^2 + 3(4 + 6)^2 \\ 2^3 + 3^2 + 3(10)^2 \\ 8 + 9 + 3(100) \\ 8 + 9 + 300 \\ 17 + 300 \\ 317 \end{array}$$