Order of Operations

Given an expression like $2 + 3 \times 4$, it matters what order we do the operations in. If we add 2 and 3 and then multiply the result by 4, we would get a different answer than if we multiply 3 and 4 and then add 2. So mathematicians came up with a particular order that operations are done in. The order is this:

1. expressions in parentheses are done first

2. exponentiation (powers) are done next

3. multiplication and division are done next

4. addition and subtraction are done last

The mnemonic PEMDAS (Please Excuse My Dear Aunt Sally) is helpful for remembering the order. For two operations at the same level (like multiplication and division), work from left to right. For instance, $3 \times 4/6$ is done by multiplying 3 and 4 to get 12 and then dividing by 6 to get 2.

Knowing order of operations is especially important when entering things on a calculator. Suppose we want to compute $\dfrac{1 + 2}{4}$. An extremely common mistake is to enter it as `1+2/4`. The problem with this is since division is done before addition, the calculator computes $1 + \frac{2}{4}$ and gets 1.5.

To fix the problem, use parentheses when entering it, like so: `(1+2)/4`. In general, when entering fractions or complicated expressions into calculators, either use lots of parentheses, or break up the calculation into a bunch of small parts.

Exercises

Compute the following using a calculator.

1. $\dfrac{3+18}{2 \cdot 27 - 3}$

2. $3 + \dfrac{\frac{4 \cdot 5 - 6}{2 \cdot 31}}{3 \cdot 15 + 9}$

Answers

1. $\dfrac{3+18}{2\cdot 27 - 3} = .4118$ (rounded to 4 decimal places)

2. $3 + \dfrac{\frac{4\cdot 5 - 6}{2\cdot 31}}{3\cdot 15 + 9} = 3.0042$ (rounded to 4 decimal places)