Chapter 2: CALCULATORS and FORMULAS

Overview

2.1 Exponents and Calculator Usage
2.2 Variables and Formulas
2.3 More Variables and Formulas - Excel

Note to student: Beginning with this Chapter, unless specifically requested, answers need not be in a specific form; equivalent answers are acceptable. For example, exercise 2.2A, #1 has \(-6\frac{1}{2}\) as the answer; -6.5, \(-\frac{13}{2}\), -650%, or any other equivalent answer is acceptable.
While we are on multiplication, did you know that there is some short hand? Remember when we started multiplication we did:

\[ 6+6+6+6+6+6+6+6+6 = 54 \]

but we did it a bit shorter

\[ 9 \times 6 = 54 \]

There is a way to write multiplication in shorthand if you do the same thing over and over again:

\[ 2 \times 2 \times 2 \times 2 \times 2 = 128 \]

For the shorthand we write \( 2^7 = 128 \).

That little 7 means the number of times that we multiply 2 by itself and is called an **exponent**; sometimes we call it a **power**. Here are a couple more examples:

\[ 5^3 = 125 \quad 7^2 = 49 \quad 2^4 = 16 \]

Pretty slick. You won’t have to memorize them . . . yet, but you should be familiar enough with them to be able to recognize them.

Some of the easiest to calculate are the powers of 10. Try these:

\[ 10^4 = 10,000 \quad 10^8 = 100,000,000 \quad 10^3 = 1,000 \]

**EXAMPLE**

Evaluate \( 7^4 \)

\[ 7^4 = 7 \times 7 \times 7 \times 7 \]

\[ 49 \times 7 \times 7 \]

\[ 343 \times 7 \]

\[ 2401 \]

Answer: 2401
Order of Operations

The last small note to finalize all your abilities in arithmetic is to make sure you know what you need to do when you have multiple operations going on at the same time. For example,

\[ 2 + 3 \times 4 - 5 \]

If you were to read that from left to right you would first add the 2 and the 3 to get 5 and then multiply by 4 to get 20 and then subtract 5 to get 15.

Unfortunately, that doesn’t jibe with what we have learned about what multiplication is. Remember that multiplication is a shorthand way of writing repeated addition. Technically we have:

\[ 2 + 3 \times 4 - 5 = 2 + 4 + 4 + 4 - 5 = 9. \]

Ahh, now there is the right answer. It looks like we need to take care of the multiplication as a group, before we can involve it in other computations. **Multiplication is done before addition and subtraction.**

Here is another one:

\[ 4 \times 3^2 - 7 \times 2 + 4 \]

Now remember that exponents are shorthand for a bunch of multiplication that is hidden, so we need to take care of that even before we do multiplication:

\[ 4 \times 3^2 - 7 \times 2 + 4 = \text{Take care of exponents} \]
\[ 4 \times 9 - 7 \times 2 + 4 = \text{Take care of multiplication} \]
\[ 36 - 14 + 4 = \text{Add/Sub left to right.} \]
\[ 22 + 4 = 26. \]

Now division can always be written as multiplication of the reciprocal, so make sure you do division before addition and subtraction as well.

Look at that. We have established an order which the operations always follow, and we need to know it if we are to get the answers that the problem is looking for:

1st – Exponents
2nd – Multiplication and Division (glues numbers together)
3rd – Addition and Subtraction (left to right)

Parentheses can change everything. We put parentheses when we intend on grouping (or gluing) numbers together manually. Though they all have the same numbers and operations, see the difference between these:

\[
\begin{align*}
2 - 3 \times 6^2 \div 2 &= 2 - (3 \times 6)^2 \div 2 = (2 - 3) \times 6^2 \div 2 = (2 - 3 \times 6)^2 \div 2 = \\
2 - 36 \div 2 &= -1 \times 36 \div 2 = (2 - 18)^2 \div 2 = (2 - 18) \times 36 \div 2 = \\
2 - 54 &= -52 = -36 \div 2 = -36 = -18 = 256 \div 2 = 128
\end{align*}
\]