Lesson #17

Evaluating Variable Expressions Using Order of Operations

What is Order of Operations?

The order of operations rules apply to evaluating arithmetic expressions. The accepted rules use the following order of application:

- Parentheses
- Exponents
- Multiplication
- Division
- Addition
- Subtraction

How Do I Remember This Order?

We frequently use the acronym "PEMDAS" to help students remember the correct order of operations. Another trick that helps is to memorize a sentence like:

"Please Excuse My Dear Aunt Sally"

Whatever method you use, what is most important is that you use the operations correctly, in the right order!

An Example:

Evaluate the following mathematical expression: $-3^2 - 2(5-8) * 9/3$

- We start by simplifying the Parentheses: $-3^2 - 2(-3) * 9/3$
- Next, comes the Exponent: $-9 - 2(-3) * 9/3$
- Next comes Multiplication and Division. We get rid of the remaining ( ) by multiplying:

$$= -9 + 6 * 9/3$$

- We do the rest of the multiplication and division steps in the order they appear:

$$= -9 + 54/3$$

$$= -9 + 18$$

- Finally we use Addition and/or Subtraction to get our final result:

$$= \mathbf{9}$$

What If There Is A Variable?

Evaluate the following mathematical expression for $x = -3$:

$$-x^3 - 2x^2 + 5|x|$$

- Our first step is to substitute -3 in for every x in the expression:

$$-(-3)^3 - 2(-3)^2 + 5|-3|$$

- In this case, the absolute value symbol is considered a "parentheses" so we start there:

$$-(-3)^3 - 2(-3)^2 + 5(3)$$

- Continue to use PEMDAS to simplify the expression:

$$= -(-27) - 2(9) + 5(3)$$

$$= 27 - 18 + 15$$

$$= 9 + 15$$

$$= \mathbf{24}$$

What If There Are Multiple Variables?

Evaluate the following mathematical expression for $a = -1 \; and \; b = 3$:

$$ab^2 - 2b^a + 3a$$

- Our first step is to substitute -1 in for every a and 3 in for every b in the equation:

$$(-1)(3)^2 - 2(3)^{-1} + 3(-1)$$

- Use PEMDAS to simplify the expression - There is no work to do within parentheses, so start with E:

$$= (-1)(9) - 2(\frac{1}{3}) + 3(-1)$$

$$= -9 - \frac{2}{3} - 3$$

$$= -\frac{27}{3} - \frac{2}{3} - \frac{9}{3}$$

$$= -\frac{29}{3} - \frac{9}{3}$$

$$= -\mathbf{\frac{38}{3}}$$