Topic 2 – Lesson 3: The Order of Operations

Student Outcomes

* Students evaluate numerical expressions. They recognize that in the absence of parentheses, exponents are evaluated first.

Warm-Up

We remember the order of operations with the acronym PEMDAS. Define each part of PEMDAS.

P =

E =

M =

D =

A =

S =

**Guided Practice**

Guided Practice Answers

What operation is evaluated first?

*Exponents* ( )

What operations are evaluated next?

*Multiplication and division, from left to right* ( )

What operations are always evaluated last?

*Addition and subtraction, from left to right* ( )

What is the final answer?

* Evaluate the next two exercises.

**Solve.**

Try to have students do the following examples on their own.

Guided Practice with Word Problems

* The last important rule in the order of operations involves grouping symbols, usually parentheses. These tell us that in certain circumstances or scenarios, we need to do things out of the usual order. Operations inside grouping symbols are always evaluated first, before exponents and any operations.

Consider a family of that goes to a soccer game. Tickets are each. The mom also buys a soft drink for. How would you write this expression?

How much will this outing cost?

Consider a different scenario: The same family goes to the game as before, but each of the family members wants a drink. How would you write this expression?

Ask students…Why would you add the and first?

We need to determine how much each person spends. Each person spends ; then, we multiply by people to figure out the total cost.

How much will this outing cost?

* The last complication that can arise is if two or more sets of parentheses are ever needed; evaluate the innermost parentheses first, and then work outward.
* Try Exercises 6 and 7.

Exercises 6–7

1.
2.

If students are confused trying to divide by , reiterate the rule about nested parentheses.

Why is Order Important?

* Let’s take a look at how parentheses and exponents work together. Sometimes a problem will have parentheses, and the values inside the parentheses have an exponent. Let’s evaluate the following expression.

Place the expression on the board.

* We will evaluate the parentheses first.

Why is order important?

Which value will we evaluate first within the parentheses? Evaluate.

First, evaluate , which is ; then, add . The value of the parentheses is.

Evaluate the rest of the expression.

Place the expression on the board:

What do you think will happen when the exponent in this expression is outside of the parentheses?

Will the answer be the same?

Answers will vary.

Which should we evaluate first? Evaluate.

Parentheses

What happened differently here than in our last example?

The was not raised to the second power because it did not have an exponent. We simply added the values inside the parentheses.

Evaluate to find the final answer.

What was different between the two expressions?

Answers may vary. In the first problem, a value inside the parentheses had an exponent, and that value was evaluated first because it was inside of the parentheses. In the second problem, the exponent was outside of the parentheses, which made us evaluate what was in the parentheses first; then, we raised that value to the power of the exponent.

Closing (5 minutes)

* When we evaluate expressions, we use one set of rules so that everyone arrives at the same correct answer. Grouping symbols, like parentheses, tell us to evaluate whatever is inside them before moving on. These rules are based on doing the most powerful operations first (exponents), then the less powerful ones (multiplication and division, going from left to right), and finally the least powerful ones last (addition and subtraction, going from left to right).

Lesson Summary

Numerical Expression: A *numerical expression* is a number, or it is any combination of sums, differences, products, or divisions of numbers that evaluates to a number.

Statements like “” or “” are not numerical expressions because neither represents a point on the number line. Note: Raising numbers to whole number powers are considered numerical expressions as well, since the operation is just an abbreviated form of multiplication, e.g., .

Value of a Numerical Expression: The *value of a numerical expression* is the number found by evaluating the expression.

For example: is a numerical expression, and its value is .

Homework - Evaluate each expression.