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Order of Operations with Parentheses

Unit 1 Lesson 4

Math 5

Students will be able to:

- Identify the order of operation in a numerical expression (with parentheses).
- Demonstrate understanding on the order of operations in a numerical expression (with parentheses).
- Evaluate numerical expressions (with parentheses) using PEMDAS rule.
- Evaluate numerical expressions (with parentheses) using the funnel method.
- Solve problems involving numerical expressions (with parentheses), following the correct order of operations.

Order of Operations with Parentheses

Key Vocabulary:

Numerical Expression

Order of Operations

PEMDAS Rule

Funnel Method

Evaluate

Parentheses

Brackets

Braces

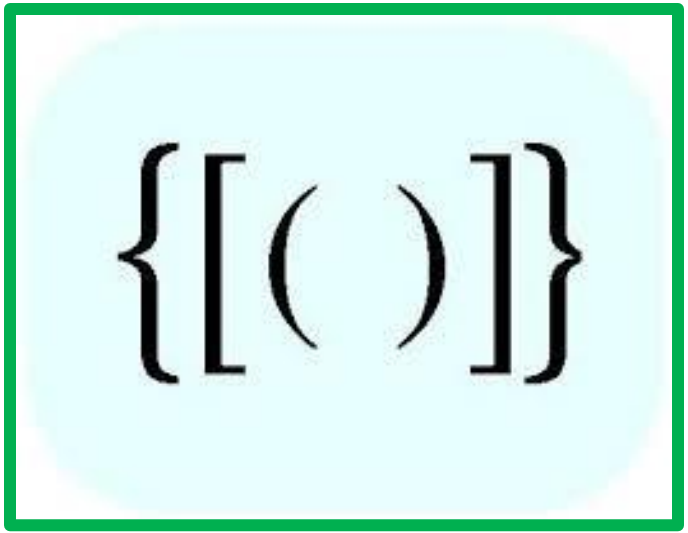
Order of Operations

Numerical expressions are evaluated correctly by following certain order of operations. Some expressions don't involve any **grouping symbols**, such as parentheses and the like, but there are also some that have these.

Order of Operations

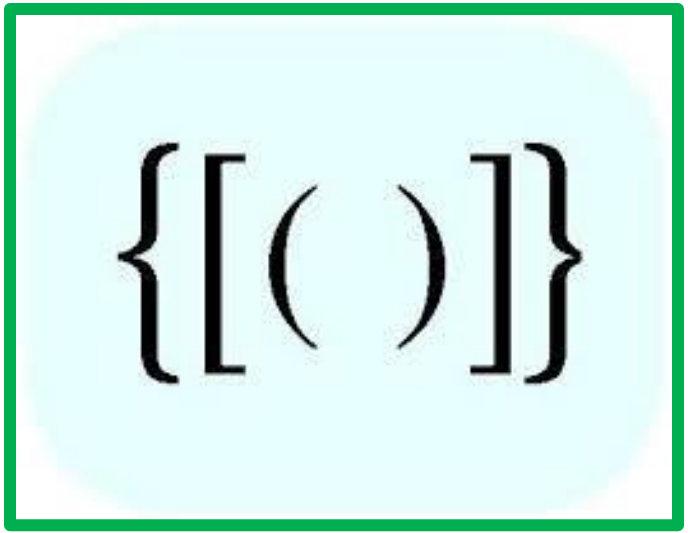
For numerical expressions with no grouping symbols, we make use of the **MDAS** rule. What will happen if numerical expressions have these grouping symbols? Will the rule change?

Grouping Symbols



Reading and analyzing a verbal statement is very important in writing a correct numerical expression. There are instances where some numbers and operations are **grouped togeth** using symbols.

Grouping Symbols



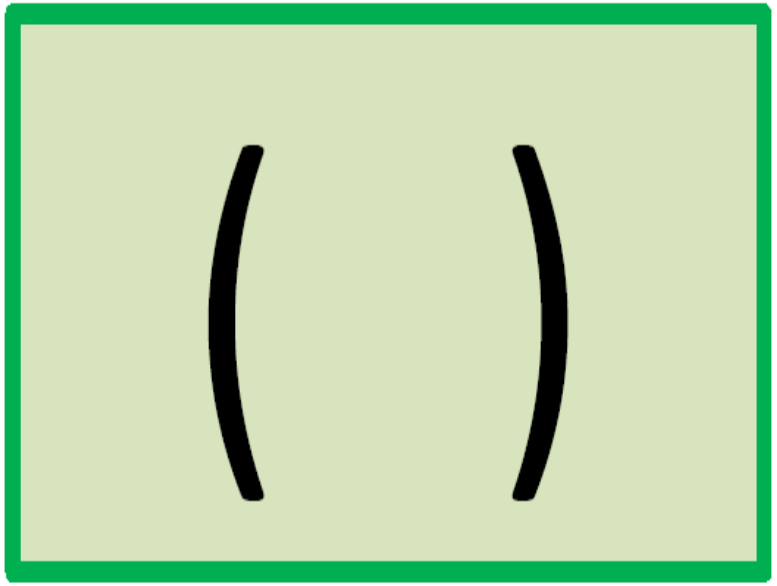
Parentheses are not the only grouping symbols used. There are other symbols that you need to know.

What are these symbols?

Order of Operations with Parentheses

Grouping Symbols

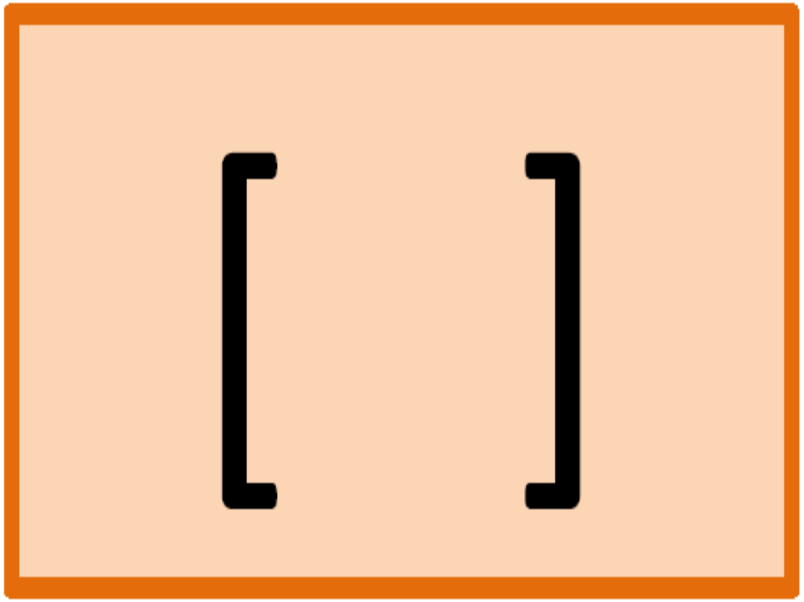
Parentheses



Order of Operations with Parentheses

Grouping Symbols

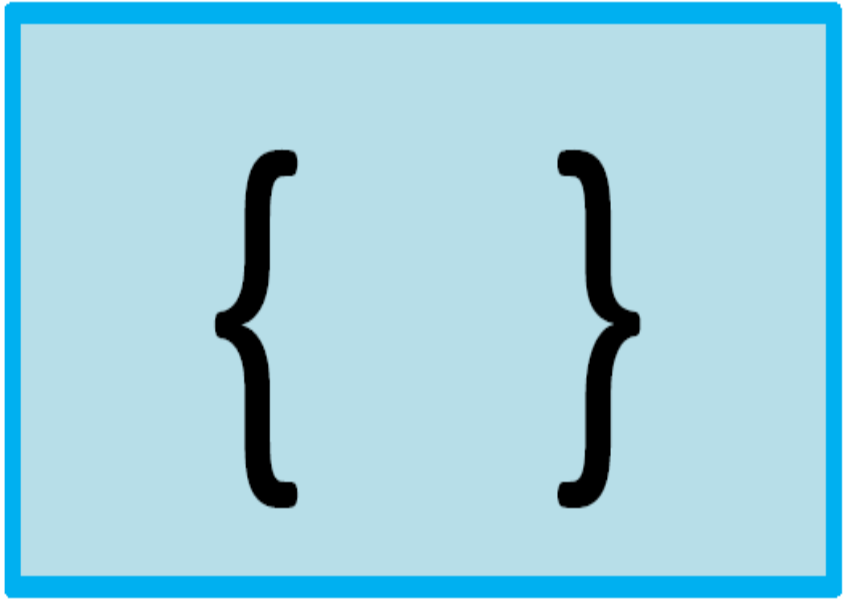
Brackets



Order of Operations with Parentheses

Grouping Symbols

Braces



The Order of Symbols

Aside from operations, symbols such as parentheses, brackets and braces, follow a specific order too!

First, you carry out the operation inside the PARENTHESES.

Then, you carry out the operation inside the BRACKETS.

Lastly, you carry out the operation inside the BRACES.

Evaluating Numerical Expressions with Parentheses

The word **EVALUATE** means to "**calculate**" or to "**get**" the value of a given expression. This time, the numbers and operations in a numerical expression are grouped using the different grouping symbols. How are these types of numerical expressions evaluated?

Example:

Paul and Ana were asked to evaluate the numerical expression:

$$4 \times (2 + 5) - 9 \div 3$$

Their solutions are shown on the next slide

Order of Operations with Parentheses

Paul

$$4 \times (2 + 5) - 9 \div 3$$

$$4 \times 7 - 9 \div 3$$

$$28 - 9 \div 3$$

$$28 - 3$$

$$25$$

Ana

$$4 \times (2 + 5) - 9 \div 3$$

$$8 + 5 - 9 \div 3$$

$$13 - 9 \div 3$$

$$13 - 3$$

$$10$$

There could only be ONE correct answer.

Who do you think did it right?

Is it Paul or Ana?

To make sure that the answer is "valid" and "accurate", there are certain steps to follow. For numerical expressions without grouping symbols we use the MDAS rule. For numerical expressions involving grouping symbols such as parentheses, brackets and **braces**, the PEMDAS rule is used.

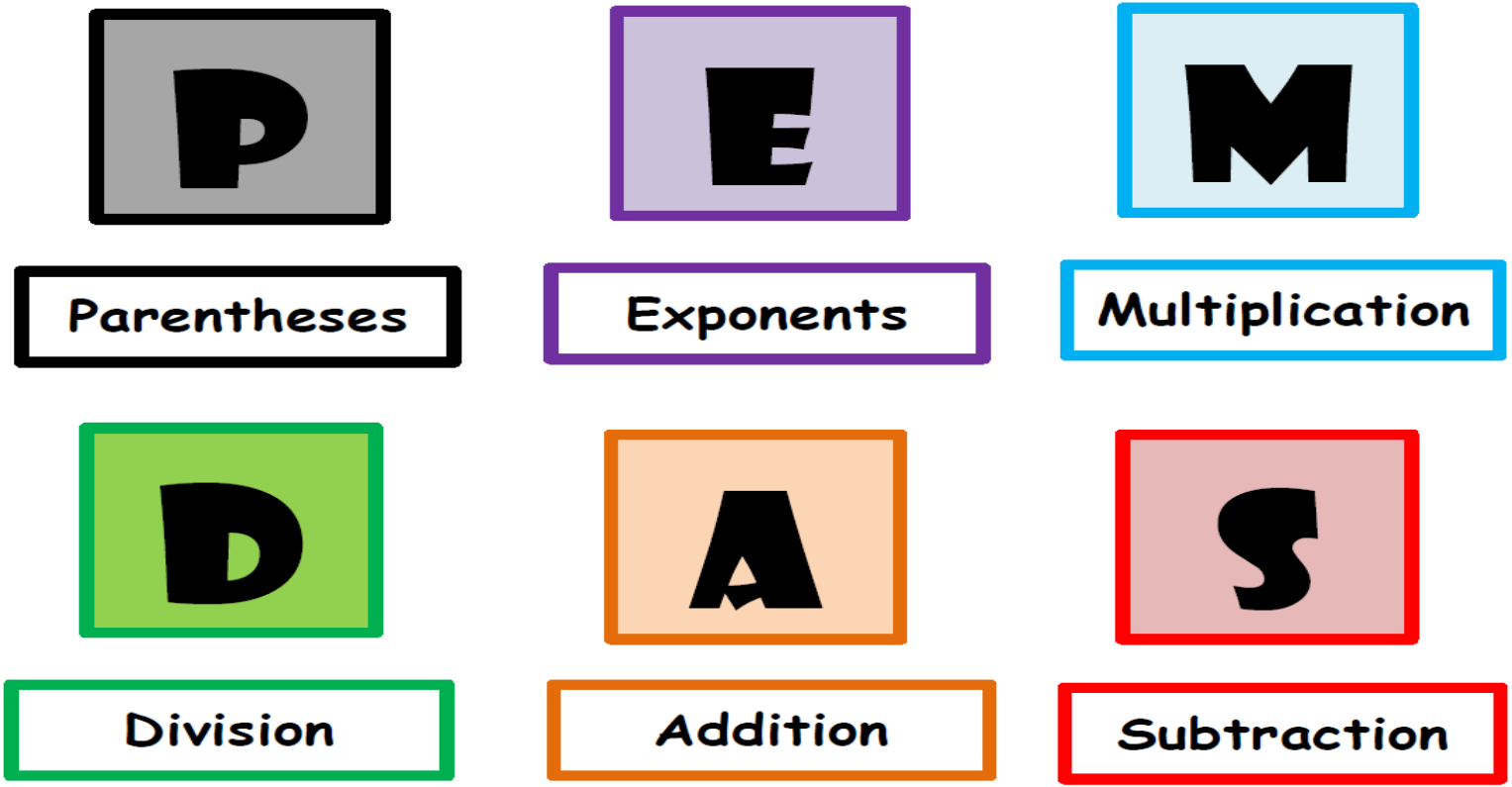
What is PEMDAS rule???

PEMDAS Rule

Applying the **PEMDAS** rule is very important in evaluating numerical expressions. Why is PEMDAS very important? What does it stand for?

Let's see on the next slide!

Order of Operations with Parentheses



PEMDAS Rule

Following the **PEMDAS** rule is very important especially if your goal is to get the correct answer. Below are the steps to make sure that you are doing it right!!!

Step #1

You work on the numbers and operations inside the grouping symbols first. Work on the calculation inside the parentheses, then the calculation inside the brackets and lastly, the calculations inside the braces.

Step #2

Find the value of numbers with exponents (if there is any).

Step #3

If all the calculations inside the grouping symbols are done, you may now start working on the calculations from left to right like the arrows below.

Step #4

Work on with MULTIPLICATION or DIVISION, whichever comes first, from LEFT to RIGHT.

Step #5

Work on with ADDITION or SUBTRACTION, whichever comes first, from LEFT to RIGHT.

So… going back to Paul and Ana's solution:

Paul

$$4 \times (2 + 5) - 9 \div 3$$

$$4 \times 7 - 9 \div 3$$

$$28 - 9 \div 3$$

$$28 - 3$$

$$25$$

Ana

$$4 \times (2 + 5) - 9 \div 3$$

$$8 + 5 - 9 \div 3$$

$$13 - 9 \div 3$$

$$13 - 3$$

$$10$$

Order of Operations with Parentheses

Who did it right? Who followed the steps properly?

Paul did it right!!!

Let's find out how he did it right!

Paul

$4 \times (2 + 5) - 9 \div 3$

$4 \times 7 - 9 \div 3$

$28 - 9 \div 3$

$28 - 3$

25

→ Work on the calculations inside the parentheses.

Follow the MDAS rule working from LEFT to RIGHT.

Multiply or Divide
(whichever comes first)
Add or Subtract
(whichever comes first)

Ana, on the other hand, failed to follow the PEMDAS rule.

$$4 \times (2 + 5) - 9 \div 3$$

$$8 + 5 - 9 \div 3$$

$$13 - 9 \div 3$$

$$13 - 3$$

$$10$$

→

Not working on the calculations inside grouping symbols first, like parentheses, is totally a WRONG move! Thus, the answer will be INCORECT ☹

Sample Problem 1:

Two students were asked to evaluate the numerical expression below. Who do you think has the correct answer? Why do you think so?

$$(8 + 7) \div 3 + (4 - 2) \times 3$$

Order of Operations with Parentheses

Student A

$$(8+7) \div 3 + (4-2) \times 3$$

$$15 \div 3 + (4-2) \times 3$$

$$15 \div 7 - 2 \times 3$$

$$15 \div 5 \times 3$$

$$15 \div 15$$

$$1$$

Student B

$$(8+7) \div 3 + (4-2) \times 3$$

$$15 \div 3 + (4-2) \times 3$$

$$15 \div 3 + 2 \times 3$$

$$5 + 2 \times 3$$

$$5 + 6$$

$$11$$

Sample Problem 1:

Two students were asked to evaluate the numerical expression below. Who do you think has the correct answer? Why do you think so?

$$(8 + 7) \div 3 + (4 - 2) \times 3$$

Solution: (Answers may vary)

Student B's solution is correct. He/she followed the PEMDAS rule correctly.

Sample Problem 2:

Evaluate the numerical expression $(10 + 2) \div 4 \times [(15 \div 3) - 4]$ using the PEMDAS rule.

Solution:

$$(10 + 2) \div 4 \times [(15 \div 3) - 4]$$
$$12 \div 4 \times [(15 \div 3) - 4]$$
$$12 \div 4 \times [5 - 4]$$
$$12 \div 4 \times 1$$
$$3 \times 1$$
$$3$$

The FUNNEL Method

If the steps involved in evaluating numerical expressions confuse you. Like when you see the numbers and they all dance in your head.

There is a method that you can use that will help you get the correct answer one step at a time ☺!

Order of Operations with Parentheses

The FUNNEL Method

Paul's Solution

$$4 \times (2 + 5) - 9 \div 3$$

$$4 \times 7 - 9 \div 3$$

$$28 - 9 \div 3$$

$$28 - 3$$

$$25$$

The solution follows the shape of a funnel.

Order of Operations without Parentheses

THE FUNNEL METHOD

1. Write the expression horizontally.
2. Determine the operation that should be done first, following the MDAS rule and underline it.
3. Perform the said operation and rewrite the expression the way it appeared in the original expression.

Order of Operations without Parentheses

4. Underline the next operation following the MDAS rule.

5. Continue performing the operations one at a time, rewrite the expression after each step until you've completed all the operations... and you have one value left.

Example:

Using the **Funnel Method** evaluate the numerical expression $(3 \times 4) - [(24 \div 2) - 7] + 6$.

Solution:

$$(3 \times 4) - [(24 \div 2) - 7] + 6$$

$$(3 \times 4) - [12 - 7] + 6$$

$$(3 \times 4) - 5 + 6$$

$$12 - 5 + 6$$

$$7 + 6$$

$$13$$

Sample Problem 3:

Evaluate the expression $[10 - 4 \div (9 - 5)] - 3 \times 3$ using the funnel method.

Solution:

$$[10 - 4 \div (9 - 5)] - 3 \times 3$$

$$[10 - 4 \div 4] - 3 \times 3$$

$$[10 - 1] - 3 \times 3$$

$$9 - 3 \times 3$$

$$9 - 9$$

$$0$$

Order of Operations in Real World

The **PEMDAS** rule is also used to solve real-life problems. These problems happen on a daily basis, without us realizing that we are using such rule. Below is an example:

Example:

A shoe store is on sale and it gives a $30 discount for each pair of shoes. Mel and his friend bought 4 pairs of shoes with an original price of $80, and both decided to share the cost.

a. Write a numerical expression to represent the situation.

Solution:

$$(80 - 30) \times 4 \div 2$$

b. How much should each of them pay?

Solution:

$$(80 - 30) \times 4 \div 2$$

$$50 \times 4 \div 2$$

$$200 \div 2$$

$$100$$

They have to pay $100 each.

Sample Problem 4:

Kyle saved for year and he was able to raise $2000. He gave his mom $500 and divided the remaining amount into 4 parts and kept 1 part for himself. Then, he bought a new shirt that cost $100.

a. Write a numerical expression to represent the situation.
b. How much money did he have left?

Solution:

a. Write a numerical expression to represent the situation.

$$(2000 - 500) \div 4 - 100$$

b. How much money did he have left?

$$(2000 - 500) \div 4 - 100$$

$$1500 \div 4 - 100$$

$$375 - 100$$

$$\mathbf{275}$$

He has $275 left.