**Order of Operations**

Similar to the word **order**is the word “arrangement.” **Operations,**on the other hand, would mean **adding**, **subtracting**, **dividing**, and **multiplying**. So “**Order of Operations**”means the correct arrangement of the operations involved in a numerical expression.

For instance, James and Sally were asked to give the value of $5+2×10$.

Who do you think did it right?

**Sally**

**James**

$$5+2×10-3$$

$$5+20-3$$

$$25-3$$

$$22$$

$$5+2×10-3$$

$$7×10-3$$

$$70-3$$

$$67$$

Sally and James came up with different answers. Both steps may look **OK,**but only **ONE** is correct, and the other one is just deceiving you

Questions like “**What should go first?**” and “**What must be done next?**” are just some of the many questions when asked to **EVALUATE** numerical expressions.

**Evaluating Numerical Expressions** (without Parentheses)

The word **EVALUATE** means to “calculate” or to “get” the value of a given expression. Going back to the answers of James and Sally, they were asked to evaluate $5+2×10-3$.

**Sally**

**James**

$$5+2×10-3$$

$$5+20-3$$

$$25-3$$

$$22$$

$$5+2×10-3$$

$$7×10-3$$

$$70-3$$

$$67$$

As mentioned earlier, there could only be **ONE** correct answer. Below is a comparison of the order of operations each of them used.

$$5+2×10-3$$

**Multiplication**

$$5+20-3$$

**Addition**

$$25-3$$

**Subtraction**

$$22$$

$$5+2×10-3$$

**Addition**

$$7×10-3$$

**Multiplication**

$$70-3$$

**Subtraction**

$$67$$

**Sally**

**James**



So who got it right??? **Sally** got it right!!!

In Mathematics, we must ensure that answers are **accurate** and **valid**. How do we ensure they are “accurate” and “valid”? Why is James incorrect?

To get an “accurate” and “valid” answer, certain rules must be followed. You can’t just do anything whichever you like and however, you would want to. **What are those RULES?**

**Multiplication – Division – Addition – Subtraction**(MDAS)

Following a **pattern**, **arrangement**, or **order** in evaluating numerical expressions will lead you to the correct answer. Let’s first evaluate numerical expressions **without parentheses** using the **MDAS** rule.

D

A

S

M

**Subtraction**

**Addition**

**Division**

**Multiplication**

**Step #1**

**Always work from left to right, like the arrows below.**

**Step #2**

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

**Step #3**

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

Let’s find out why Sally got it right and James didn’t!

**James’s Solution**

Here, James went from **left** to **right**, but failed to follow the steps. He first **ADDED**, **MULTIPLIED**,then **SUBTRCATED**… which is terribly **incorrect**!

$$5+2×10-3$$

**Addition**

$$7×10-3$$

**Multiplication**

$$70-3$$

**Subtraction**

$$67$$

$$5+2×10-3$$

$$7×10-3$$

$$70-3$$

$$67$$

**Sally’s Solution**

Sally got it right because she followed the **MDAS** rule. **MULTIPLY** or **DIVIDE** (whichever comes first), then **ADD** or **SUBTRACT** (whichever comes first), from left to right!

$$5+2×10-3$$

**Multiplication**

$$5+20-3$$

**Addition**

$$25-3$$

**Subtraction**

$$22$$

$$5+2×10-3$$

$$5+20-3$$

$$25-3$$

$$22$$

**WARNING!!!... one wrong move and you’ll get it all WRONG ☹!**

**Example:**

Sam and Paul were asked to evaluate $15+4×5-10÷2$**.** Each of their solutions is shown below. Who among the two followed the MDAS rule? Explain your answer.

**Paul**

**Sam**

$$15+4×5-10÷2$$

$$19×5-10÷2$$

$$95-10÷2$$

$$85÷2$$

$$42.5$$

$$15+4×5-10÷2$$

$$15+20-10÷2$$

$$15+20-5$$

$$35-5$$

$$30$$

**Solution:**

The one who did it right is Sam. He followed the MDAS rule. First, he multiplied 4 and 5 to get 20 and then got the quotient of 10 and 2, which is 5. Next, he got the sum of 15 and 20, which is 35. Lastly, he got a difference of 35 and 5. They were all done from left to right.

On the other hand, Paul is incorrect because even though he worked from left to right, he failed to follow the MDAS rule.

**Sample Problem 1:**

The numerical expression $20+28÷4×7-39$ is solved in two different ways with different answers.

1. Which of the two solutions is correct and why?
2. What makes the other one incorrect?

**Solution B**

**Solution A**

$$20+28÷4×7-39 $$

$$20+7×7-39$$

$$20+49-39$$

$$69-39$$

$$30$$

$$20+28÷4×7-39 $$

$$48÷4×7-39 $$

$$12×7-39$$

$$84-39$$

$$45$$

Solution:

1. Which among the two solutions is correct and why?

**Solution B** is correct because the MDAS rule was followed.

1. What makes the other one incorrect?

**Solution A** is incorrect because even though the operations performed were from left to right, the MDAS rule needed to be followed.

**The Funnel Method**

To make sure that you get the **CORRECT** answer, the use of the **FUNNEL METHOD** can help. Why is it called **FUNNEL METHOD**? Because it looks like a funnel! ☺

The examples we did earlier made use of the funnel method.

**Sally’s Solution**



$$5+2×10-3$$

$$5+20-3$$

$$25-3$$

$$22$$

The solution follows the shape of a funnel.

**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.**
4. **Underline the next operation following the MDAS rule.**
5. **Continue performing the operations one at a time, and rewrite the expression after each step until you’ve completed all the operations… and have one value left.**

**Example:**

Evaluate the numerical expression $3+12÷4×2-8$using the funnel method.

Solution:

$$3+12÷4×2-8$$

$$3+3×2-8$$

$$3+6-8$$

$$9-8$$

$$1$$

**Sample Problem 2:**

Evaluate the following numerical expressions.

1. $10+5×6÷10-13$
2. $45÷15×3+2-4+3$

Solution:

1. $10+5×6÷10-13$

 $10+30÷10-13$

 $10+3-13$

 $13-13$

 $0$

1. $45÷15×3+2-4+3$

 $3×3+2-4+3$

 $9+2-4+3$

 $11-4+3$

 $7+3$

 $10$

**Order of Operations in the Real World**

The MDAS rule is also used to solve real-life problems. These problems happen daily without us realizing that we are using this rule. Below is an example:

**Example:**

Martha bought 5 pairs of pants for $30 each. She paid the cashier $200.

1. Write a numerical expression that represents the problem.

**Solution:** $200-5×30$

1. How much money does Martha have left?

**Solution:** $200-5×30$

$ 200-150$

$50$

Martha has $50 left.

**Sample Problem 3**:

Read the problem below and answer the questions that follow.

Paul bought 4 burgers for $2.50 each and 4 medium fries for $1.25.

1. Write a numerical expression that represents the problem.
2. How much money did Paul spend?

**Solution:**

1. Write a numerical expression that represents the problem.

 $4×2.50+4×1.25$

1. How much money did Paul spend?

 $4×2.50+4×1.25$

 $10+4×1.25$

 $10+5$

 $ 15$

Paul spent $15 on the burgers and fries.