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Order Of Operations

When solving mathematical problems, it is usually required to do several different operations. It is important to do the operations with care since it is necessary to follow methodologies which lead to correct results.

The order of operations consists in rules which tell what to do first to solve the problem. Next, it is shown the order of operations.

P	**P**arenthesis and grouping symbols **( ) { } [ ]**			
E	**E**xponents 2^3	**R**	**R**adicals $\sqrt{9}$	
M	**M**ultiplication Left → $5x3$	**D**	**D**ivision Right → $\frac{9}{3}$	Multiplications and Divisions are always solved from Left to Right.
S	**A**ddition Left → $8 + 11$	**R**	**S**ubtraction Right → $10 - 4$	Addition and Subtraction are always solved from Left to Right.

Simplify the next expression: $7 + (6\ x\ 5^2 + 3)$	
$7 + (6\ x\ 5^2 + 3\ )$	Begin inside the **P**arenthesis. Work on the **E**xponent, then **m**ultiply
$7 + (\ 6\ x\ 25 + 3\ )$	
$7 + (\ 150 + 3\ )$	Now, **a**dd

$7 + (\ 153\ )$	Inside the Parenthesis there are no more operations
$7 + 153$	It is time for addition outside the Parenthesis
160	Final result

Simplify the next expression: $(\ 7^2\ +\ (18 -\ 9\ +\ 52\ ))\ +\ 3^2$	
$(\ 7^2\ +\ (18 -\ 9\ +\ 52\ ))\ +\ 3^2$	Since there are two **P**arentheses, it is important to begin with the **P**arenthesis which is deeper into the expression.
$(\ 7^2\ +\ (61\ ))\ +\ 3^2$	After it, work with the **E**xponents
$(\ 49 + 61\ ) + 9$	Now, **A**dd numbers inside the second **P**arenthesis
$110 + 9$	Then, do the final **A**ddition since the **P**arentheses were removed
119	Final result

Solve the following exercises about the order of operations:

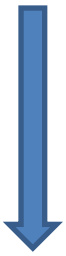
$5(2)^4 + (24\ \div 8) - 3^4$	$12 - 5(8 - 2) + (3 - 7)^2$
$4^3 - \left[2^2 - \sqrt{9}(8 \div 2 - 2)\right]$	$5 + 2[(-4)^2 - 7(6 - 2)]$
$[(-10)\ -\ \{4^2\ -\ (-10)\ \}] \bullet (4\ -\ (-7))$	$20 + \{8 - [2(5 - 9) + (7 - 2)^2]\}$

$[(-3)-\{-6+(-3)\}^2]\times(-8)+(-8)$	$[\{(-3)^3+(-10)\}\times(-3)]-(-5)+(-10)$
$(12\ \div\ 6)^{\ 2}\ +\ ((14\ -\ 4)\ x\ 5^2)$	$(5+(14\ +\ 6)\ +(20\ \div\ 2)^2\ )\ x\ 4^2$

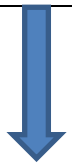
Isolating a Variable.

There are many scientific field where it is important to know how to isolate a variable such as in: Mathematics, Physics, Chemistry, and Economy.

Next, it is described the isolation process of a variable.

			$\boldsymbol{2x-6=16}$	$\boldsymbol{10x+5=5x+20}$
Step 1	Locate the current side of the variable to isolate.		$2x-6=16$	$10x+5=5x+20$
	Both sides of the equation.	One side of the equation.		
Setp 2	Set the variable to isolate in one side of the equation. Transpose all other terms onto to the other side with the opposite operation.			$10x+5=5x+20$ Join the variable into a single term and any other terms should be in the other side of the equation. To move the terms to the other side, use their opposite operation. $10x+5-5x=20$ 5x is adding on the left side; it is transpose to the other side as a subtraction *(opposite operation)* $10x-5x=20-5$ 5 is also adding, then it passes onto

						the other side with its opposite operation *(subtraction)*
Step 3	If it is possible, reduce like terms				$10x - 5x = 20 - 5$ $5x = 15$	
Step 4	Looking at the side where the variable is located, observe the operations which includes all members and proceed to isolate the variable by moving the surrounding members onto the other side with opposite operation. Repeat this operation until the variable to isolate is alone.	$2x - 6 = 16$ $2x = 16 + 6$ $2x = 22$ $2x = \frac{22}{2}$ $\boldsymbol{x = 11}$	Operation which is present in the left side= **Subtraction** It is sent to the right side with the **addition** operator *(opposite operation)* Operation which is present in the left side= **Multiplication** Isolate the varible by **dividing** the right side *(opposite operation)*		$5x = 15$ $x = \frac{15}{5}$ $\boldsymbol{x = 3}$	Operation which is on the left side= **Multiplication** It is transposed onto the right side by **dividing** *(opposite operation)*

			$\boldsymbol{f = g\frac{mM}{d^2}}$	**Isolate M**
Step 1	Find the side of the equation of the variable to be cleared.		$\boldsymbol{f = g\frac{mM}{d^2}}$	
	Both sides	One side		
Step 2	Isolate on one side the variable to clear out. Transpose any other term onto the other side with opposite operation.			
Step 3	If it is possible, reduce like terms			
Step 4	Looking at the side where the variable is located, observe the operations which includes all members and proceed to isolate the variable by moving the surrounding members onto the other side with opposite operation. Repeat this operation until the variable to isolate is alone.		$\boldsymbol{f = g\frac{mM}{d^2}}$ $\boldsymbol{\frac{f}{g} = \frac{mM}{d^2}}$ $\boldsymbol{\frac{fd^2}{g} = mM}$	Operation in the right side = **Multiplication** Move it to the left side using the **division** *(opposite operation)* Operation which is at right side = **Multiplication**

		$\frac{fd^2}{gm} = M$	Transpose it onto the left side by **dividing** *(opposite operation)*

Solve next equations by isolating the variable.

$x + 6 = 11$	$\frac{x}{2} = 5$
$6x + 4 = 8$	$-9x - 13 = -103$
$6 = \frac{a}{4} + 2$	$2(n + 5) = 2$
$2(4x - 3) - 8 = 4 + 2x$	$\frac{5x}{2} = 3x + 5$
$\frac{x}{2} + \frac{x}{3} = 5$	$\frac{5}{6} = \frac{k - 29}{k}$
$\frac{5x + 6}{4} = 3x - 2$	$\frac{x + 5}{2} = \frac{x + 2}{3}$

Isolating in Formulas

$y = y_0 + \frac{1}{2}(V + V_f)t$	Clear for V_f	$a = \frac{V - V_0}{t}$	Isolate V_0
$F_x = F \cdot Cos\theta$	Clear for F	$V^2 = V_0^2 + 2a(x - x_0)$	Isolate X_0
$V = \frac{x}{t}$	Clear for t	$x = x_0 + V_0F + \frac{1}{2}at^2$	Isolate t^2
$A = \frac{1}{2}h(b + b')$	Clear for b	$MN = \frac{b + b'}{2}$	Isolate b'

Convert from Decimal to Percentage and Vice versa

Handling a conversion of percentages to decimals correctly will help you to do application problems which include: discount concepts, taxes, profit, depreciations, amortization, among others which are constantly used in different areas such as: business administration, accounting, life insurance, medical care, banking, risk analysis, and so for.

To convert a **percentage to a decimal number**, one should divide the percentage number by 100, as in: $\mathbf{90}\% = 90 \div 100 = .90$ $\mathbf{35}\% = 35 \div 100 = .35$ $\mathbf{7}\% = 7 \div 100 = .07$ $\mathbf{6.8}\% = 6.8 \div 100 = .068$ $\mathbf{0.4}\% = 0.4 \div 100 = .004$	To convert a **number to a percentage,** one should divide the percentage number by 100, as in: $\mathbf{0.74} = 0.74 * 100 = 74\%$ $\mathbf{9.2} = 09.2 * 100 = 920\%$ $\mathbf{0.045} = 0.045 * 100 = 4.5\%$ $\mathbf{8} = 8 * 100 = 800\%$ $\mathbf{0.74} = 0.74 * 100 = 74\%$

Write the next percentages in decimal format	Write the next numbers in percentage form.
65%	5
115.9%	19
0.05%	0.1
8.4%	4.78
94%	.0487
96.7%	3.59
5%	.8
.03%	.67

TECHNIQUE OF CROSSMULTIPLYING	
DIRECT	**INVERSE**
It occurs when both variables increase or decrease their values. $$A \rightarrow B$$ $$C \rightarrow x$$ $$x = \frac{B*C}{A}$$ **Example:** 70 gallons of paint are required to beautify 5 houses in a building apartment. How many gallons of paint will be required to paint 12 apartments like these? $$gallons \rightarrow houses$$ $$\mathbf{70 \rightarrow 5}$$ $$\mathbf{x \rightarrow 12}$$ $$\mathbf{x = \frac{12*70}{5} = 168}\ gallons$$	It occurs when one variable increases its value and the other one does not or vice versa. $$A \rightarrow B$$ $$C \rightarrow x$$ $$x = \frac{A*B}{C}$$ **Example:** If three workers paint a house in 10 days, how many days will be needed with eight workers? $$wokers \rightarrow houses$$ $$\mathbf{3 \rightarrow 10}$$ $$\mathbf{8 \rightarrow x}$$ $$\mathbf{x = \frac{3*10}{8} = 3.75}\ days$$

Application Problems

1) A car ran 279 km with 61 liters of gasoline, find the kilometers it can cover with one liter?

2) In 50 liters of sea water there are 1300 grams of salt, how many sea water liters do we need to obtain 11,600 grams of salt?

3) Working forty hours a week, a man gets paid $12,000. If the works fifty hours next week, how much will he earn?

4) In a poultry farm, there are 300 hens which can eat a truck of grain in 20 days. If 100 hens are added in the farm, compute how many days will the hens take to eat the same truck of grain?

5) A group of students hire a bus for a study-trip. Initially, 21 students were attending the trip so the price per student was as low as 8 euros. If the study-trip was only attended by 12 students, how much will each one of them pay for it?

6) Romeo gave Juliet a dozen of roses and he paid $150 for it. How many roses would he get if he paid with $280?

7) If 25% of a quantity is 68, what is 43% of the same quantity?

8) When buying a car of $88,000 pesos, we receive a discount of 7.5%. What is the final amount of money to pay for the vehicle?

9) In this retail store, an item is sold with a gain of 15% over its cost. If it was bought in $ 800 pesos. Find its selling price.

10) An article is sold by losing 20% over its purchase price. Determine the selling price of this article which purchase price was $1,500.