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Worksheet 3b: ***Using the Order of Operations***

View Tutorial 3b

Objective: *Use the rules of the order of operations to evaluate expressions. Be able to simplify exponent expressions and evaluate an expression using substitution and the order of operations.*

Order of Operation: *PEMDAS**

1. ***P***arenthesis: Simplify expressions inside grouping symbols. i.e. parenthesis or brackets.
2. ***E***xponents: Evaluate all powers.
3. ***M***ultiply & ***D***ivide: Do all multiplications and divisions from left to right. Whichever comes first!
4. ***A***dd & ***S***ubtract: Do all additions and subtractions from left to right. Whichever comes first!

* The acronym ***PEMDAS*** is often used to help remember the order of operations. **PEMDAS** or the phrase, "**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally" stands for: **P**arenthesis, **E**xponents, **M**ultiply, **D**ivide, **A**dd, **S**ubtract.

It should be noted however, #3 in the order of operations does multiplication and division at the same time from left to right – NOT multiplication *then* division.

$$15 \div 5 \bullet 3 = 9$$

This expression is evaluated from left to right; both multiplication and division, whichever comes first. So $(15 \div 5=3)$, then multiply that result by 3, $(3 \bullet 3 = 9)$. The result of the expression is 9.

A common mistake is to evaluate the multiplication first $(5 \bullet 3 = 15)$ and then evaluate the division $(15 \div 15 = 1)$. As stated above this expression is equal to 9 not 1.

Also #4 in the order of operations does addition and subtraction at the same time from left to right – NOT addition *then* subtraction.

Exponents

The algebraic expression x^n represents a product in which each factor is the same. The small raised n is the exponent and it tells how many times the base, x, is used as a factor.

Example: Evaluate 3^4.

$3^4 = 3 \bullet 3 \bullet 3 \bullet 3$

$= 81$

Therefore, an expression with like bases can be simplified using exponents.

Example: Simplify $x \bullet x \bullet x \bullet x$.

$x \bullet x \bullet x \bullet x = x^4$

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Write as an expression using exponents:

1. 7•7•7 ___ **2.** 3•p•p ___ **3.** 9(b)(b)(b)(b)(b) ___

Evaluate each expression:

4. 2^3 _____ **5.** 10^5 _____ **6.** 4^4 _____

Use your calculator to evaluate each expression: (Don't forget the order of operations.)

7. $3 \bullet 7^5$ _____ **8.** $6^3 + 7^4 + 8^5$ _____ **9.** $3^5 \bullet 4^4$ _____

You can evaluate expressions using the *order of operations*. Remember to do all operations within grouping symbols first.

Example 1: Evaluate $15 - 12 \div 4$

$15 - 12 \div 4$
$15 - 3$
12

Example 2: Evaluate $57 - 4(3 + 8 \div 4) + 3^2$

$57 - 4(3 + 2) + 3^2$
$57 - 4(5) + 3^2$
$57 - 4(5) + 9$
$57 - 20 + 9$
$37 + 9$
46

Evaluate each expression using the order of operations:

10. $10 + 8 \bullet 1$ _____ **11.** $3^2 \div 3 + 2^2 \bullet 7 - 20 \div 5$ _____

12. $12(20 - 17) - 3 \bullet 6$ _____ **13.** $\dfrac{15 + 60}{30 - 5}$ _____

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14. $60 - 7(5 + 6 \div 2) + 2^4$ _____

15. $2 + 8 \bullet 3^2$ _____

16. $33 - 3[4 \bullet (7 - 5)] + 3^2$ _____

17. $48 + 2[12 \div (2 \bullet 3)]$ _____

18. $48 \div 6 \bullet 2 + 4$ _____