Study Guide: 5.7 Order of Operations

5.7 The student will evaluate whole number numerical expressions, using the order of operations limited to parentheses, addition, subtraction, multiplication, and division.

What you need to know: How to simplify expressions with more than two operations using the order of operations and explain each step.

Essential Questions:

- What is the order of operations?
- Why is there a specific order of operations?
- When would you use the order of operations?
- How does the order of operations simplify an expression?

Essential Knowledge:

- An expression, like a phrase, has no equal sign.
  Example: 3 + 6
- Expressions are simplified by using the order of operations.
- The order of operations tells the computation order to follow in simplifying an expression.
- The order of operations is as follows:
  1) First, complete all operations within grouping symbols. If there are grouping symbols within other grouping symbols, do the innermost operation first.
  2) Second, evaluate all exponential expressions.
  3) Third, multiply and/or divide in order from left to right.
  4) Fourth, add and/or subtract in order from left to right
- An exponent is the little number above a bigger number that tells you how many times to multiply the number times itself.
  Example) 2^3 means 2 x 2 x 2 = 8
  Example) 4^2 means 4 x 4 = 16

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Key Vocabulary:

Expression: Numbers, symbols and operation symbols (such as + and ×) grouped together that show the value of something WITHOUT an equal (=) sign

Example: 2 x 3

Equation: A mathematical statement that says that two expressions have the same value; any number sentence with an equal sign (=)...think EQUAtion EQUAl sign

Example: 6 + 7 = 13

Operation: Addition, subtraction, multiplication, or division

Equality: Two mathematical expressions that have the same value, separated by equal sign

Example: 3 + 5 = 2 + 6 or 5 x 4 = 20

Parentheses: Parentheses or "round brackets" used in pairs to group things together

Example: (3 x 4) + 5

Evaluate: To find the value of something; to solve.

Order of operations: The rules that say which calculation comes first in an expression.

Sequence: The order of something

What is the order of operations?

Think of Please Excuse My Dear Aunt Sally... **PEMDAS**!

P= Parentheses and other grouping symbols

First, complete all operations within grouping symbols. If there are grouping symbols within other grouping symbols, do the innermost operation first.

E= Exponents and roots (we do not use these in fifth grade)

Second, evaluate all exponential expressions.

MD= Multiplication and/or Division

Third, multiply and/or divide in order from left to right.

AS= Addition and/or Subtraction

Fourth, add and/or subtract in order from left to right

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Evaluate the following expression. What do you get?

5 + 3 x 7

Some people say 56 and some say 26, but only one is correct. This is why the order of operations is so important. Let's use the order of operations and find out which one is correct!

To solve an expression with multiple operations, ALWAYS write PEMDAS down like this:

P
E
MD
AS

This will help you to remember to do each step in order. Check off each letter as you finish it.

5 + 3 x 7

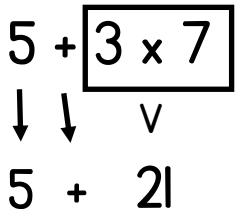
P- Parentheses. Do we have any grouping symbols in this problem? No. Let's move on.

E- Do we have any exponents? No.

MD- Do we have any multiplication or division? YES!

Starting from the left and moving to the right, we track each number and operation symbol until we find a multiplication OR division problem. Whichever comes first, we put a box around it and then solve it, putting an answer below it with a carrot.

After we've evaluated the problem in the box, we copy the rest of the problem from OUTSIDE the box, including any operation symbols:



Do we have any more multiplication or division in our problem? NO! Move to the next step.

AS- Do we have any addition or subtraction? Yes!

Once again, starting from the left and looking to the right, we solve whichever comes first- addition or subtraction. We only have one operation left to do, so we add the 5 + 21 and get...

26!

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Here is another example. Evaluate: $15 - 3 \times 2 + (2 + 12 \div 4 \times 3)$

$15 - 3 \times 2 + \boxed{(2 + 12 \div 4 \times 3)}$

V

$15 - 3 \times 2 + (2 + \boxed{12 \div 4} \times 3)$

V

$15 - 3 \times 2 + (2 + \boxed{3 \times 3})$

V

$15 - 3 \times 2 + \boxed{(2 + 9)}$

V

$15 - \boxed{3 \times 2} + 11$

V

$\boxed{15 - 6} + 11$

V

$\boxed{9 + 11}$

V

20

Since we have parentheses, we start there. Treat the problem within the parentheses as its own problem and follow PEMDAS.

In the parentheses we don't have any parentheses (P) or exponents (E). We *do* have multiplication and division (MD). So we go from left to right and solve them.

We skip 2 + 12 because that is not multiplication or division. We find 12 ÷ 4 is the first M or D problem, box it and solve it to get 3. Then, we copy the rest of the problem down.

We still have more M or D in the parentheses so we box and solve that (3x3), write our answer and then copy the rest of the problem.

Now that we've found the value of what was in the parentheses, we can work on the rest of the problem.

We don't have any more P or E, so we look to see if we have any M or D. Starting from left to right, we find that our first M or D is 3 x 2 and box it, solve it, and copy the rest of the problem.

We don't have any more M or D, so we move on to A and S.

Scanning from left to right, we find our first A or S is 15–6 so we box it, solve it, and copy the rest of the problem down.

We only have one expression left, so we solve it and get our answer, 20!