

## ORDER OF OPERATIONS

A handout from The Learning Center - Trident Technical College

There is a standard procedure and a simple memory device to help remember how to compute order of operations expressions. Consider the sentence, "Please excuse my dear Aunt Sally." Look at the first letters.

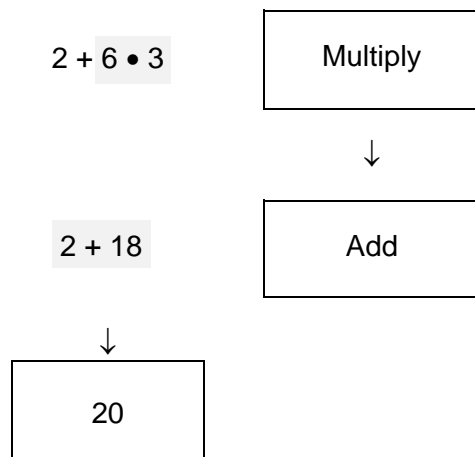
<b><u>P</u>lease</b>	<b><u>P</u>arentheses (and fraction bars)</b>
	By parentheses, we mean any symbols of inclusion, such as parentheses ( ), brackets [ ], and braces { }.
<b><u>E</u>xcuse</b>	<b><u>E</u>xponents</b>
<b><u>M</u>y</b>	<b><u>M</u>ultiplication</b>
<b><u>D</u>ear</b>	<b><u>D</u>ivision</b>
<b><u>A</u>unt</b>	<b><u>A</u>ddition</b>
<b><u>S</u>ally</b>	<b><u>S</u>ubtraction</b>

To simplify any numerical expressions:

1. Work all expressions within parentheses (inside to outside) and above or below fraction bars.
2. Do all exponents.
3. Do all multiplication and division, left to right.
4. Do all addition and subtraction, left to right.

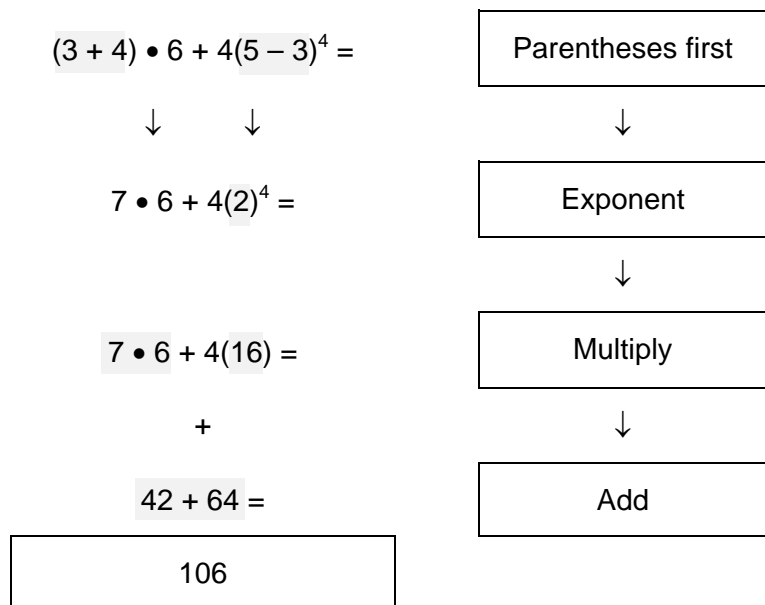
**Example 1:** Simplify  $2 + 6 \cdot 3$

**Solution:** We work these in order of priority.



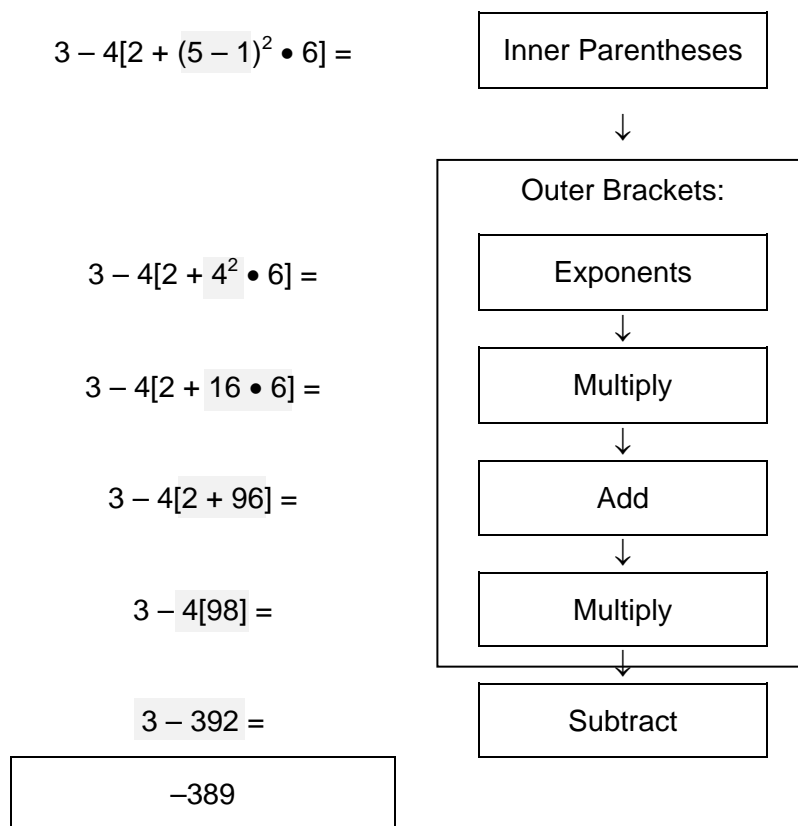
**Example 2:** Simplify  $(3 + 4) \cdot 6 + 4(5 - 3)^4$

**Solution:** Here we do the operations within the parentheses first.



**Example 3:** Simplify  $3 - 4[2 + (5 - 1)^2 \cdot 6]$

**Solution:** Here we have parentheses and brackets. We simplify the inner parentheses first, then the outer.



**Example 4:** Simplify  $\frac{2+(5-1)^3+19}{8+2(2+1)^4} =$

**Solution:** Here we have a fraction bar. Therefore, we simplify the expression above and below the bar, using the usual priorities: parentheses first.

$\frac{2+(5-1)^3+19}{8+2(2+1)^4} =$	Parentheses
	↓
$\frac{2+(4)^3+19}{8+2(3)^4} =$	Exponents
	↓
$\frac{2+64+19}{8+2(81)} =$	Multiply
	↓
$\frac{2+64+19}{8+162} =$	Add
$\frac{85}{170} = \frac{1}{2}$	

**Example 5:** Simplify  $2 \cdot 3^2 + [45 - 4(6 - 3)^2]^2 =$

**Solution:**

$2 \cdot 3^2 + [45 - 4(6 - 3)^2]^2 =$	Inner Parentheses
	↓
$2 \cdot 3^2 + [45 - 4(3)^2]^2 =$	<div style="text-align: center;">Outer Brackets:</div> <div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: 80%;"> <div style="text-align: center;">Exponents</div> <div style="text-align: center;">↓</div> <div style="text-align: center;">Multiply</div> <div style="text-align: center;">↓</div> <div style="text-align: center;">Subtract</div> <div style="text-align: center;">↓</div> <div style="text-align: center;">Exponent</div> </div>
$2 \cdot 9 + [45 - 4(9)]^2 =$	
$2 \cdot 9 + [45 - 36]^2 =$	
$2 \cdot 9 + [9]^2 =$	
$2 \cdot 9 + 81 =$	
$18 + 81 =$	Multiply
	↓
$99$	Add

## Practice

1.  $10 - 3 \cdot 2 - 1$
2.  $4 \cdot 10 - 3 \cdot 7$
3.  $6 \cdot 3^2 + 4 \cdot 3 + 1$
4.  $(4 + 7) \cdot 8 - 2(1 + 3)^2$
5.  $\frac{2 - 3 \cdot 4^3 - 10}{2 - 3 \cdot 4^3}$
6.  $\frac{3 + (9 - 2)^2 + 23}{6 - 3(5 - 2)^3}$
7.  $2 + [3 - 2(2 + 1)]$
8.  $3^2 - [6 + 2(2 + 3)^3]$
9.  $4 + (2 - 3[5 + 6(3 + 2)^2])$
10.  $12 \div (-2)(3)$

**Answers:**

1. (3)   2. (19)   3. (67)   4. (56)   5.  $\left(\frac{20}{19}\right)$    6. (1)   7. (-1)  
8. (-247)   9. (-459)   10. (-18)