



DETAILED SOLUTIONS AND CONCEPTS - ORDER OF OPERATION
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YOU MUST BE ABLE TO DO THE FOLLOWING PROBLEMS WITHOUT A CALCULATOR!

The **Order of Operation** is a set of rules that allow us to interpret a mathematical expression, such as **$2+3(5)$** , for example. It determines which mathematical operations should be performed in what order.

1. First, carry out operations in numerators and denominators of fractions and within radicals. You might have to use steps 2 through 5!
2. Then carry out operations enclosed by **grouping symbols**, such as parenthesis (), brackets [], and braces { }.

NOTE: Given grouping symbols, the value enclosed by the innermost symbol is done first. The innermost symbol is usually a set of parentheses.

3. Exponential expressions are evaluated next.
4. Then we divide and multiply, whichever comes first, in order from left to right.
5. Lastly we add and subtract, whichever comes first, in order from left to right.

Problem 1:

Use the **Order of Operation** to simplify **$5^2 - 6(3) \div (5 + 4)$** .

We'll do the addition within parentheses first.

$$5^2 - 6(3) \div 9$$

Next, we'll evaluate the exponent.

$$25 - 6(3) \div 9$$

Now, we have to multiply and divide IN ORDER from left to right. We'll do the multiplication first!

$$25 - 18 \div 9$$

Then, we'll do the division.

$$25 - 2$$

Finally, we'll subtract to get **23**.

Problem 2:

Use the **Order of Operation** to simplify $6\sqrt{25} - 6 + [16 - 4(3)]$.

We'll do the operations within parentheses first. They are considered to be the innermost grouping symbol.

$$6\sqrt{25} - 6 + [16 - 12]$$

Next, we'll find the value within the brackets.

$$6\sqrt{25} - 6 + 4$$

Then, we will simplify the square root.

Please note that there exists an implied multiplication between **6** and $\sqrt{25}$. It is customary NOT to write a multiplication sign nor use parentheses with the radical.

$$6(5) - 6 + 4$$
 Note that now we enclosed **5** in parentheses

Now, we'll multiply!

$$30 - 6 + 4$$

We need to add and subtract IN ORDER from left to right. We'll do the subtraction first!

$$24 + 4$$

Finally, we'll add to get **28**.

Problem 3:

Use the **Order of Operation** to simplify $6.2(33.78) \div 100$.

We need to multiply and divide IN ORDER from left to right. We'll do the multiplication first!

$$209.436 \div 100$$

Thereafter, we'll do the division to get **2.09436**.

Problem 4:

Use the **Order of Operation** to simplify $(2 + 4)^2 + \sqrt{13 - 4} \div \frac{12 + 6}{3}$.

Here we have two grouping symbols, a radical and a fraction. We are allowed to carry out the addition/subtraction operation within them at the same time.

$$(2 + 4)^2 + \sqrt{9} \div \frac{18}{3}$$

and

$$6^2 + 3 \div 6$$

Next, we'll need to evaluate the exponential expression.

$$36 + 3 \div 6$$

Then, we'll have to divide.

$$36 + 0.5$$

Finally, we'll add to get **36.5**.

Problem 5:

Use the **Order of Operation** to simplify $25 - 25 \div (7 - 2)$.

We need to take care of the parentheses first.

$$25 - 25 \div 5$$

Then, we'll have to divide.

$$25 - 5$$

Finally, we'll subtract to get **20**.

Problem 6:

Use the **Order of Operation** to simplify $(10 - 3)^2 + 4(2) - (10 + 5) \div 5$.

We need to take care of the parentheses first.

$$7^2 + 4(2) - 15 \div 5$$

Next, we'll need to evaluate the exponential expression.

$$49 + 4(2) - 15 \div 5$$

Then, we'll have to multiply and divide in order from left to right. In this case, we can do both operations at the same time, but only because they are separated by a minus sign.

$$49 + 8 - 3$$

Finally, we'll add and subtract in order from left to right to get **54**.